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Elk Habitat/Timber Management Relationships on Eastside Forests of the Northern Region, USFS.

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Northern Region, USFS

and

Montana Department of Fish and Game

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INTRODUCTION

The forested environment offers many of the habitat requirements of elk east of the Continental Divide in Montana. Eastside elk habitats generally differ from those which occur west of the divide in that they tend toward climax vegetation. Also, eastside habitats are less characterized by extensive stands of timber cover than westside habitats. With demands for forest products on the upswing, coordination to protect elk habitat as well as maintain diversity of hunting recreation opportunity becomes increasingly important. These situations, plus the work by Thomas, et. al. (1976), have prompted this effort to systematically coordinate elk habitat management with long-range planning, particularly in the area of timber management.

The Task Force assigned to develop this approach first identified its objective in this effort. The objective is stated as follows:

> *To provide Eastside Zone forest resource managers with a system to understand and display consequences of forest vegetation manipulation on elk. This system will be applicable for land use planning and program planning.*

It is the team's intent that this system be applied only at the land use planning and program development levels. The relationships defined are general in nature and should not be used as a "cookbook" to treat management conflicts which may arise at the project implementation level. At the latter level, evaluation on a case-by-case basis should be made by the timber manager and the wildlife biologist. No generalized system is a substitute for professional evaluation of each local situation. Therefore, it is the Task Force's intent that this document not be construed as "hard and fast" direction, but rather as a system which gives the land manager maximum flexibility to manage elk habitat based on all land management objectives. The team believes this system incorporates those data which are most applicable and most up-to-date for the Eastside Zone.

PRECEPTS

Certain precepts serve as the foundation for the construction of the functional models of elk habitat relationships. Since these precepts are based on literature review, research findings, and management experience, they may not be completely true in every situation, but they are largely true in most situations east of the Divide. Acceptance of these precepts requires an understanding of the above perspective.

A. Adaptability of Elk. The adaptability of the species to a wide array of habitats has been documented by Murie (1951). In the Eastside Zone, highly productive elk populations occur in habitats in which forested cover types range from 30% (Gravelly Range) to 70% (Little Belt Mountains) of the total area (Basile and Lonner, in press). Optimum habitat, as described in terms of cover/forage ratio by Thomas, et. al. (1976), is a range of values in the Eastside Zone, thus calculation of a single, precise value is not relevant. *Elk are an adaptable species.*

B. Elk Security. Habitat alteration resulting from timber management activities will cause changes in elk use of the areas affected. Various Montana studies have documented at least temporary movements of population segments away from occupied habitats following disturbance by may (Lyon, 1975; Marcum, 1975; Lonner, 1974). This has also been reported from other western states, (Hershey and Leege, 1976; Rose and Bailey, unknown; Perry and Overly, 1976). Other research has shown the apparent reestablishment of use in altered (logged) habitat following the cessation of logging activity (Coop, 1971; Day, 1973). Also, productivity of elk populations in both logged and unlogged areas east of the Divide, is, by any measure available to man, good to excellent. For example, excellent reproduction (50 to 60 calves per 100 cows) has been recorded in both disturbed and undisturbed areas (Chrest and Childress, 1976). Field experience of the team members east of the Divide is coincident with these findings. *Security (primarily during the hunting season) is the habitat element first and most impacted by logging activities, although other elements are also influenced security is, at present, the most manageable aspect of elk habitat.*

C. Elk Cover Types. Winter range studies (Beall, 1976) indicate the forest stand structure (the arrangement of vegetative strata) influences the regulation of animal body temperature. This work also reported elk are strongly associated with cover types and weakly associated with forage types during the winter. Lonner's (1976) work in the Long Tom Drainage indicates a preference by elk

for sites with dense regeneration which offers security, especially during the rut and fall periods. Lyon (1976) has shown use of clearcuts in eastern Montana by elk is significantly related to the adjacent forest stand structure. These findings imply that *forest stand structure is equally or more important than habitat type in the determination of elk habitat preference on all seasonal ranges;* and *any loss of thermal cover* (see Glossary) *will be detrimental on traditional elk winter ranges.*

HABITAT PREFERENCE RELATIONSHIPS

Elk habitat preference is defined as the response of the species to its environment as related to the fulfillment of biological needs. Habitat preference is composed of a complex of variables, each of which changes in value as changes in the other variables occur. Land typing, which in concept integrates many of the variables of a complete habitat, is unavailable for the Eastside Zone at an appropriate level of sensitivity. Habitat types (Pfister, et. al., 1977) are available; however, this classification focuses on climax rather than seral stages. Photointerpretation Types (USDA, 1977) are also available for the Eastside due to recent efforts in timber management planning. These photointerpretation (PI) types are at least a crude delineation of structure or seral stage in forested types.

The task force combined Habitat Types and PI Types into a vegetation classification (Elk Habitat Type) which represents various forested elk habitat situations (Habitat Types and PI Types were previously grouped to reflect similarities in management implications, See Appendix 1.) This combination resulted in 23 elk habitat types for which models were constructed. Use of Elk Habitat Types as described above delineates a vegetation classification unit which averages 35 to 60 acres in size. This unit represents a relatively pure stand and, as a result, no consideration is given to the interspersion of types in this classification system.

Leopold (1933) advanced the concept of "edge-effect" and noted the importance of type interspersion as it relates to species abundance. Our vegetation classification system (Elk Habitat Type) does not recognize the value of interspersion and juxtaposition of types. However, the summer-fall home range of an elk is 10 to 40 square miles, thus the number of discrete "units of habitat" within this area probably numbers in the thousands (the actual number is dependent on that point at which a small unit no longer provides significant edge). It is our contention that species mobility and the number of discrete habitat units within the large seasonal home range renders small, individual edges relatively unimportant *at the appropriate level of application* of the habitat preference model (See Application of Models). Leopold (1933) contends "edge-effect" is less significant in highly mobile species. Marcum (1975), in his work in the Sapphire Range, noted high elk use of areas near ecotones, yet he also observed summer-fall selection for these areas in only one year of three.

Models for each Eastside elk habitat group are shown in Figures 1 through 14. These models depict the relationship between elk use and alteration of the elk habitat group by season and by silvicultural treatment. The models developed are based on the following generalized silvicultural practices for the Eastside (Phil Guthrie and John Joy, pers. comm.):

1. In lodgepole pine, clearcutting is the rule. Dwarf mistletoe generally prevents the application of any other system except at near-climax situations where multiple species (subalpine fir, spruce, lodgepole pine) occur.

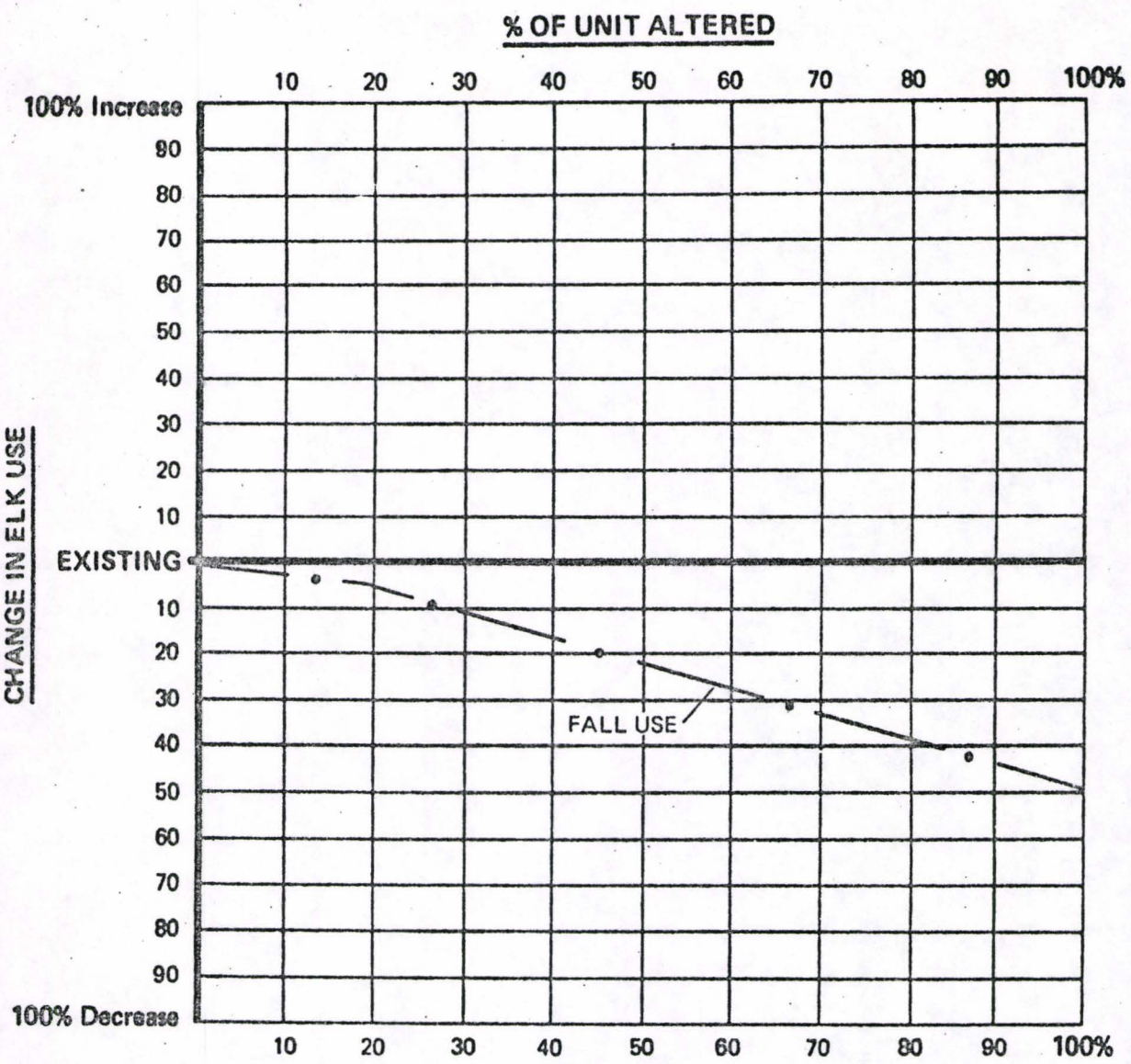
2. In wet mixed-conifer stands dominated by spruce, selection systems are most applicable. Selection of "cut" trees can and should be spread throughout the range of merchantable diameters, removing no more than 33% of any one diameter group, including the biggest trees.

3. Moist Douglas-fir habitat types with more or less even-aged stands would normally be regenerated through clearcutting, shelterwood, or seed-tree systems. All create "clearcuts" as far as elk are concerned. In dry Douglas-fir habitat types, shelterwood or selection systems are the rule.

4. Subalpine types, beginning at the point where whitebark pine is present and Douglas-fir is absent (AF(WBP)/Vasc), are normally above the elevation where we would be entering for intensive timber management. Harvest in these types would normally be salvage adjacent to existing roads.

The objective of the elk habitat preference models is to predict elk response to alteration of summer or fall habitat (two models of elk response to alteration of fall and winter habitats on an Elk Habitat Type which is restricted to the Hebgen Lake District, Gallatin National Forest are shown in Appendix II). In the context of "response to habitat alteration," response to the resultant integration of *all* habitat elements, including foraging areas, bedding sites, water escape areas, thermal cover, etc., is implied. The construction of these models is based on research findings, field experience and, where these are lacking, the expert opinion of Eastside Zone elk management and research biologists.

Figure 1: Elk Habitat Preference Model for Elk Habitat Types 11, 12, 13, and 14* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



*Includes all possible combinations of the following:

a) Habitat Types:
Pinus Flexilus Series
PP/Agsp; Andro; Feid; Putr; Syal
DF/Agsp; Field; Fesc.
DF/Syal-Agsp; Caru-Agsp

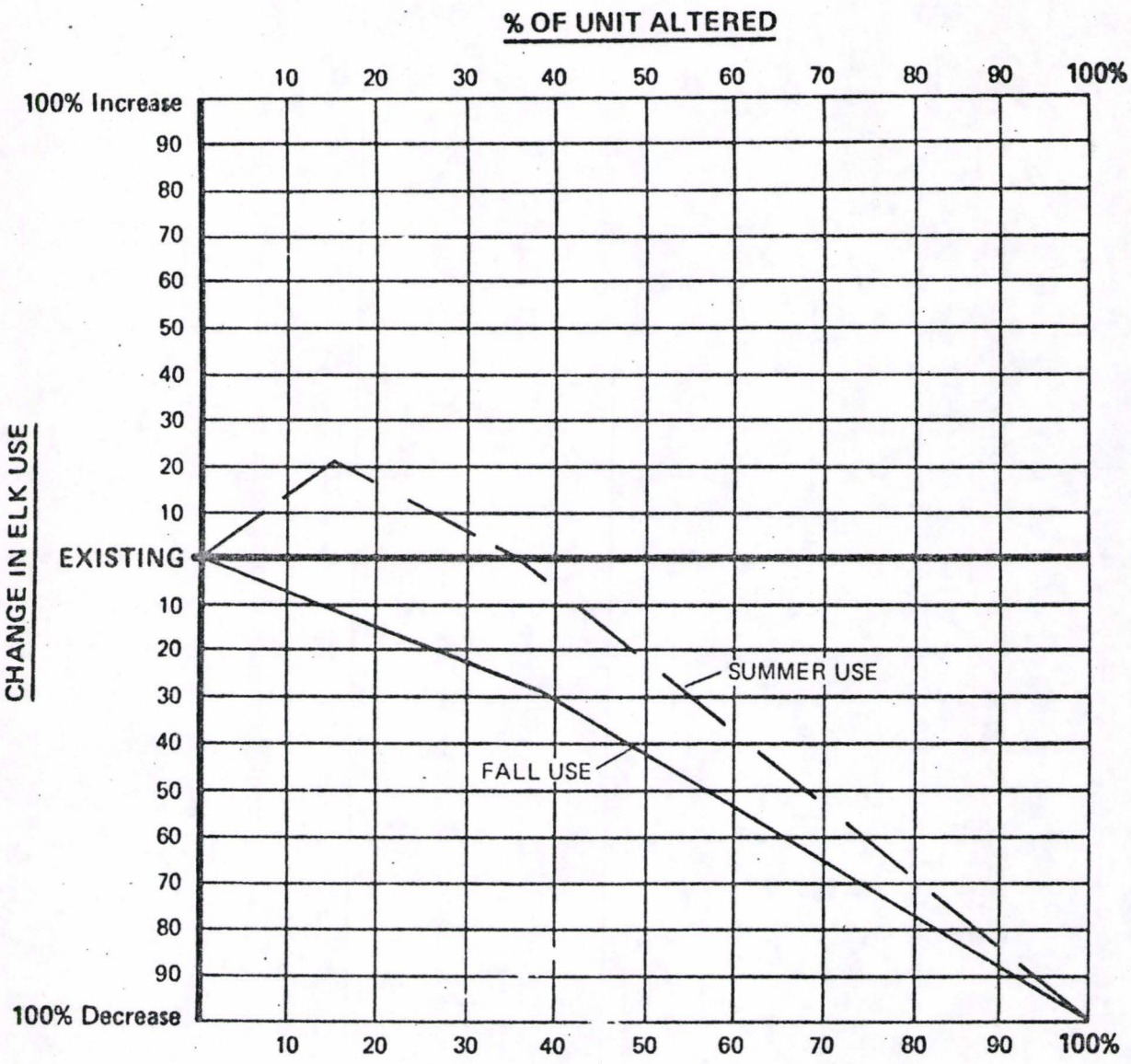
b) P.I. Types:
Includes P.I. types 11, 12, 14, 15, 17, 19, 21, 23, 25, 27, and 28. All stand heights with 40% to 100% crown cover (well to medium stocked).

Assumptions

Elk: Fall and winter range only; no summer use.

Silviculture; Selection or shelterwood harvest systems only; normally salvage along existing roads.

Figure 2. Elk Habitat Preference Model for Elk Habitat Type 21* for the summer and fall periods, Eastside Zone, Northern Region, USFS.


% OF UNIT ALTERED
10 20 30 40 50 60 70 80 90 100%
100% Increase
90 80 70 60 50 40 30 20 10
EXISTING
10 20 30 40 50 60 70 80 90
100% Decrease
CHANGE IN ELK USE
SUMMER USE
FALL USE

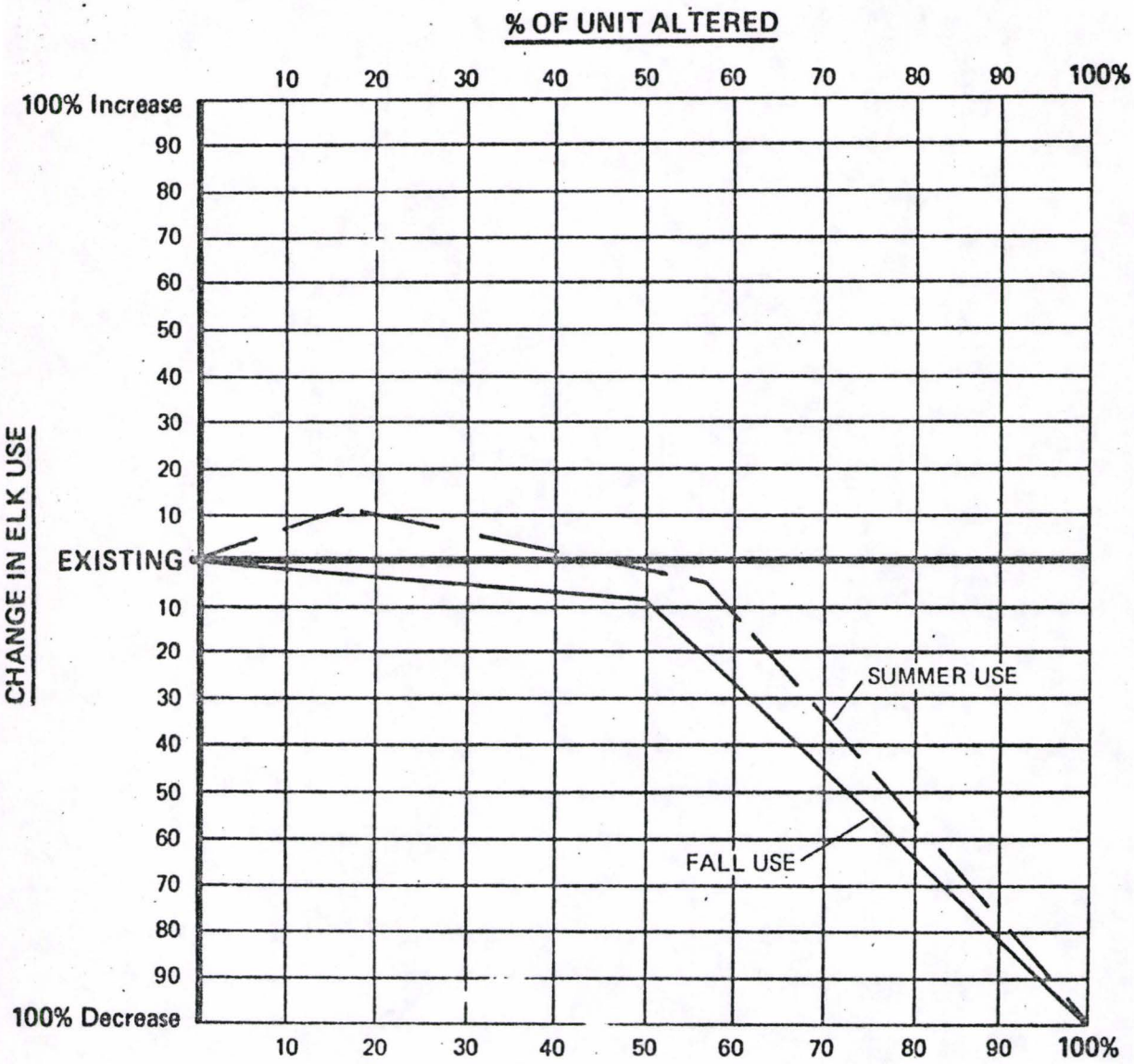
*Includes all possible combinations of the following:

a) Habitat Types:
DF/Caru-Caru; Caru-Aruv; DF/Cage
DF/Arco; Juco; Spbe; Aruv; Phma; Syal

b) P.I. Types:
Includes P.I. Types 11 and 14. Stand height greater than 40 feet. 70% to 100% crown cover (well stocked).

Assumptions:
Elk: Primarily fall range; some early summer use.
Silviculture: Even-aged harvest systems only.

Figure 3. Elk Habitat Preference Model for Elk Habitat Type 22* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



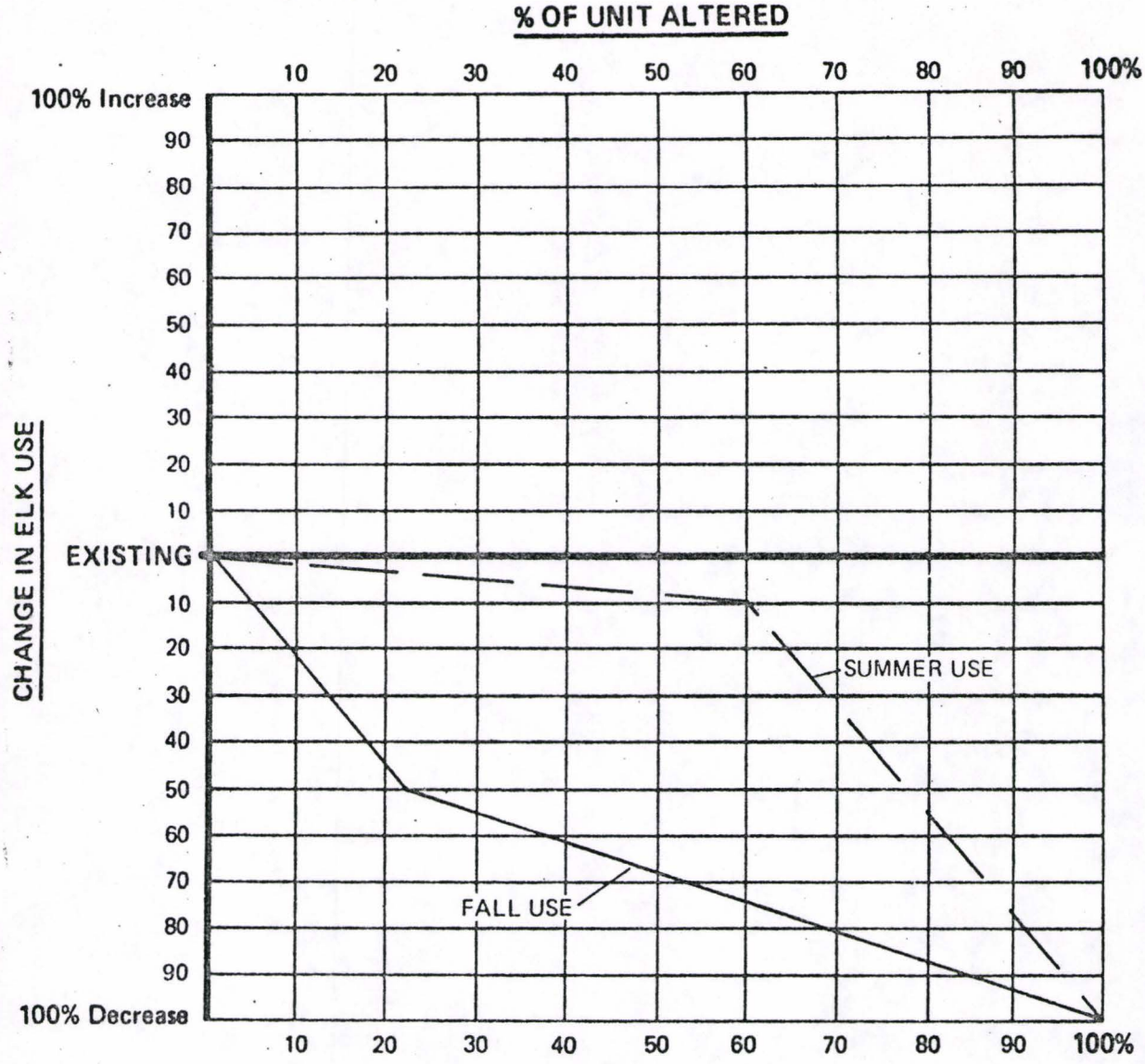
*Includes all possible combinations of the following:

a) Habitat Types:
DF/Caru-Caru; Caru-Aruv; DF/Cage
DF/Arco; Juco; Spbe; Aruv; Phma; Syal

b) P.I. Type:
Includes P.I. Types 12, 15, 19, and 21. Stand height greater than 40 feet. 40% to 70% crown cover (medium stocking).

Assumptions:
Elk: Primarily fall range; some early summer use.
Silviculture: Even-aged harvest systems only.

Figure 4. Elk Habitat preference Model Elk for Habitat Type 23* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



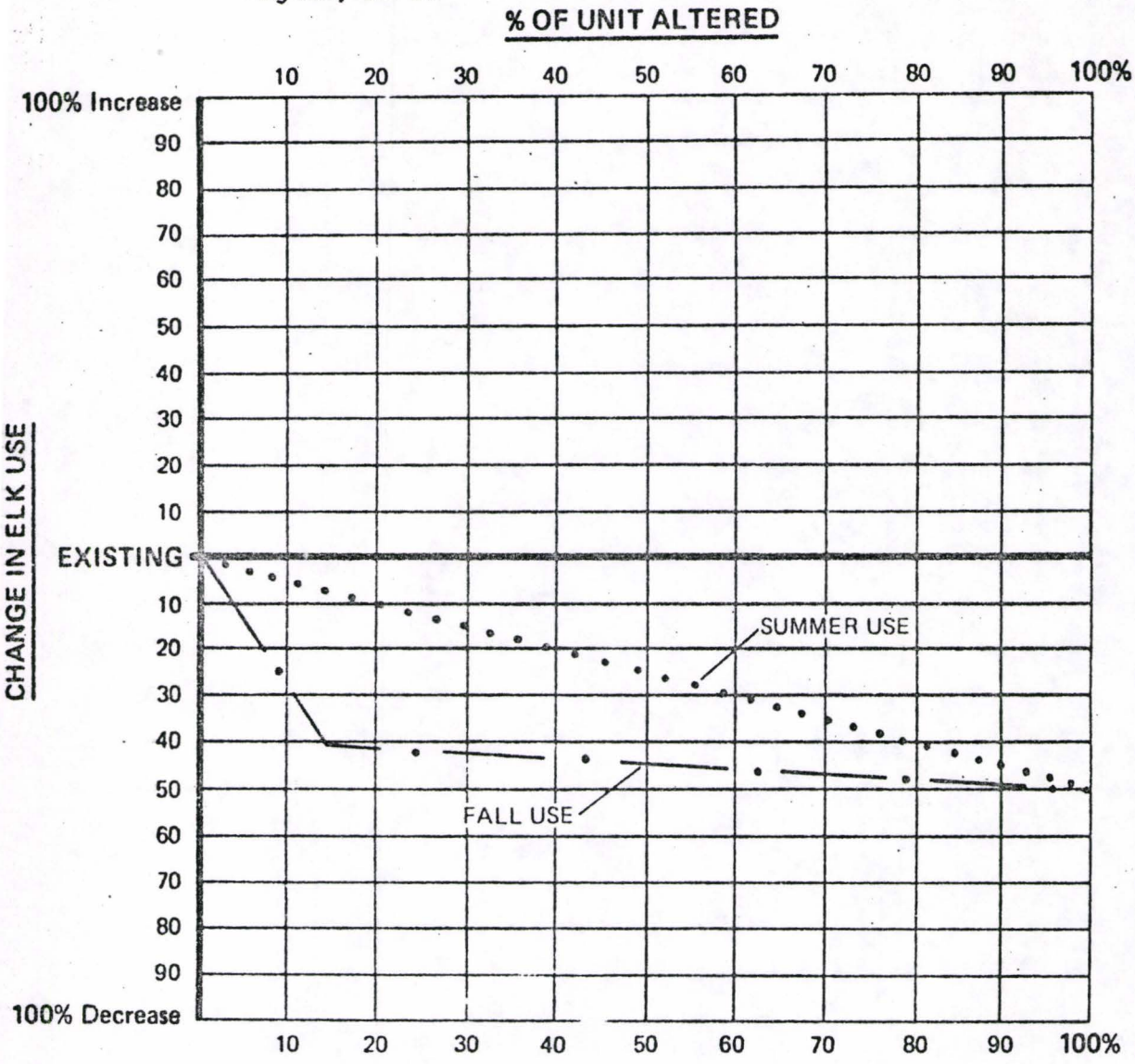
*Includes all possible combinations of the following:

a) Habitat Types:
DF/Caru-Caru; Caru-Aruv; DF/Cage
DF/Arco; Juco; Spbe; Aruv; Phma; Syal

b) P.I. Type:
Includes P.I. Types 17 and 23. Stand height greater than 40 feet. Stand two-storied and at least 15-20 feet height difference between overstory and understory. 40% to 100% crown cover (well to medium stocking).

Assumptions:
Elk: Primarily fall range with key cover value due to forest structure.
Silviculture: Even-aged harvest systems only.

Figure 5. Elk Habitat Preference Model for Elk Habitat Type 24* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



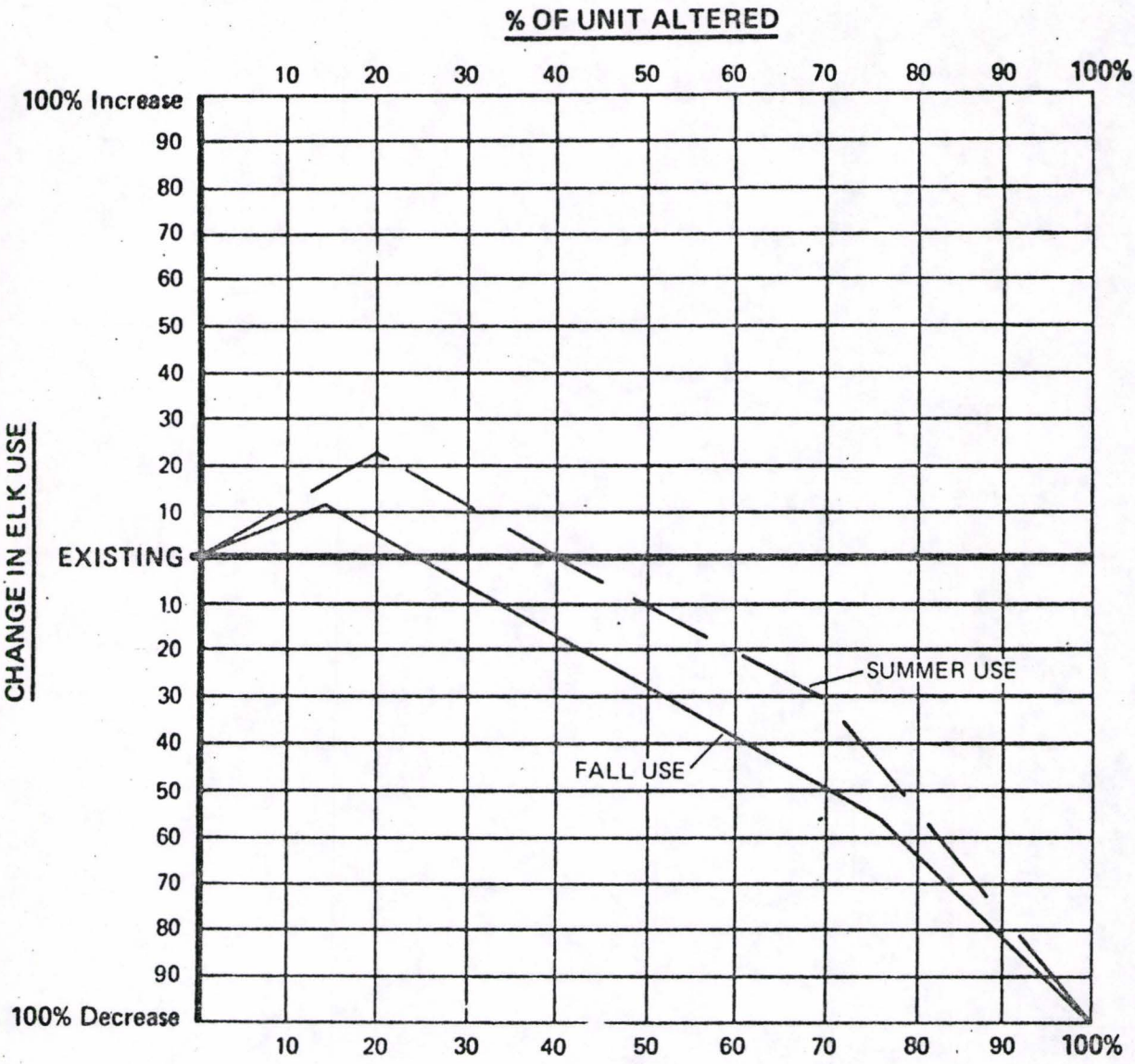
*Includes all possible combinations of the following:

a) Habitat Types:
DF/Caru-Caru; Caru-Aruv; DF/Cage
DF/Arco; Juco; Spbe; Aruv; Phma; Syal

b) P.I. Type:
Includes P.I. Types 25, 27, and 28. Stand height less than 40 feet. 40% to 100% crown cover (well to medium stocked).

Assumptions:
Elk: Primarily fall range; some early summer use.
Silviculture: Intermediate cuts (commercial and precommercial thinnings); conversion of "doghair" may result in clearcut.

Figure 6. Elk Habitat Preference Model for Elk Habitat Types 31 and 32* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



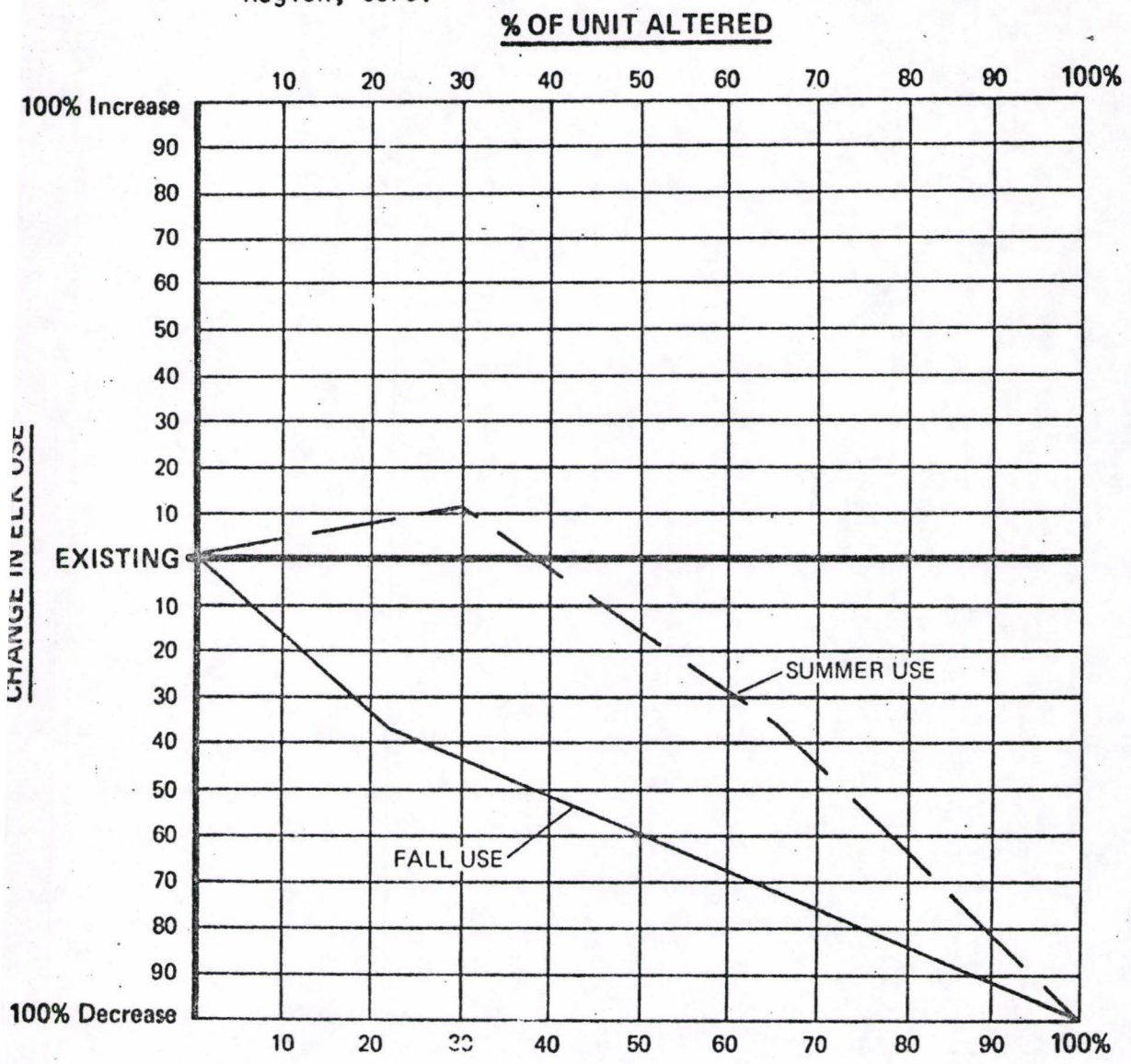
*Includes all possible combinations of the following:

a) Habitat Types:
DF, S, AF/Vaca; Libo
S/Smst, Phma
DF, AF/Xete, Vagl

b) P.I. Types:
Includes P.I. types 11, 12, 14, 15, 19, and 21. Stand height greater than 40 feet. 40% to 100% crown cover (well to medium stocking).

Assumptions:
Elk: Summer and fall range.
Silviculture: Even-aged harvest systems applicable.

Figure 7. Elk Habitat Preference Model for Elk Habitat Type 33* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



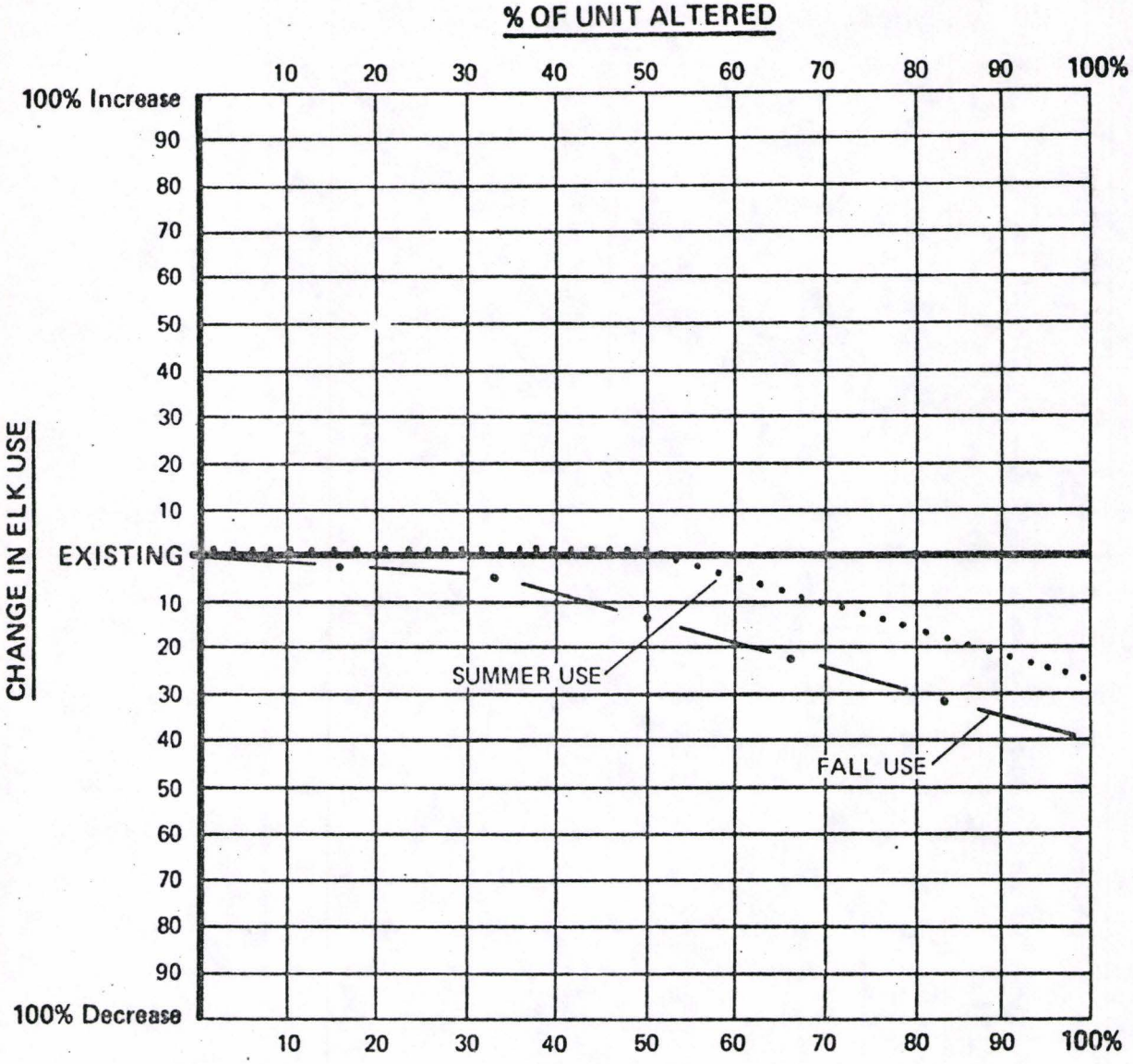
*Includes all possible combinations of the following:

a) Habitat Types:
DF, S, AF/Vaca; Libo
S/Smst, Phma
DF, AF/Xete, Vagl

b) P.I. Types:
Includes P.I. Types 17 and 23. Stand height greater than 40 feet. Stand two-storied and at least 15-20 feet height difference between overstory and understory. 40% to 100% crown cover (well to medium stocking).

Assumptions:
Elk: Summer and fall range.
Timber: Even-aged harvest systems applicable.

Figure 8. Elk Habitat Preference Model for Elk Habitat Type 34* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



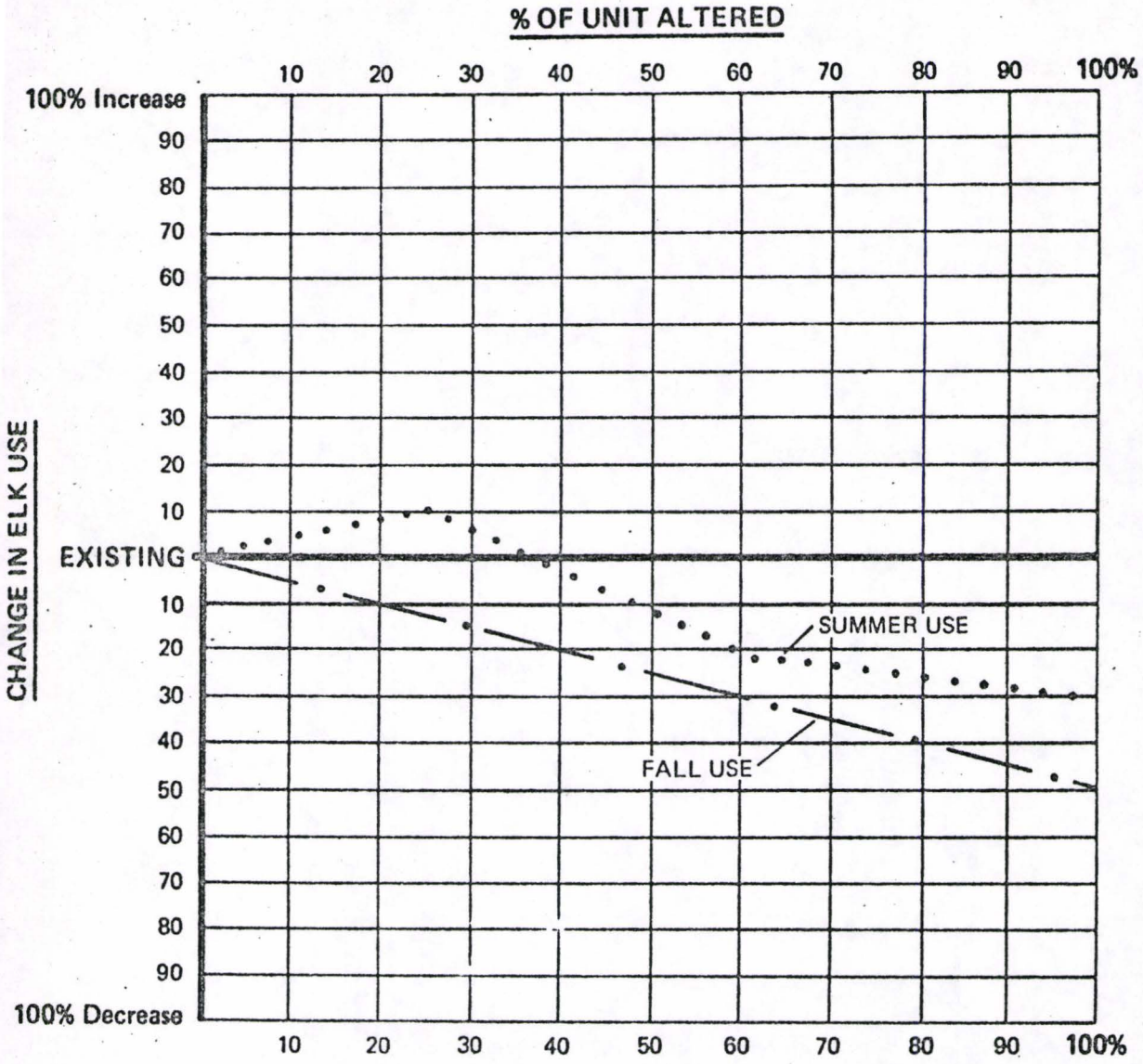
*Includes all possible combinations of the following:

a) Habitat Types:
DF, S, AF/Vaca; Libo
S/Smst, Phma
DF, AF/Xete, Vagl

b) P.I. Types:
Includes P.I. Types 25, 27, and 28. Stand height less than 40 feet. 40% to 100% crown cover (well to medium stocked).

Assumptions:
Elk: Summer and fall range.
Silviculture: Intermediate cuts (commercial and precommercial thinning); conversion of "doghair" may result in clearcut.

Figure 9. Elk Habitat Preference Model for Elk Habitat Type 41* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



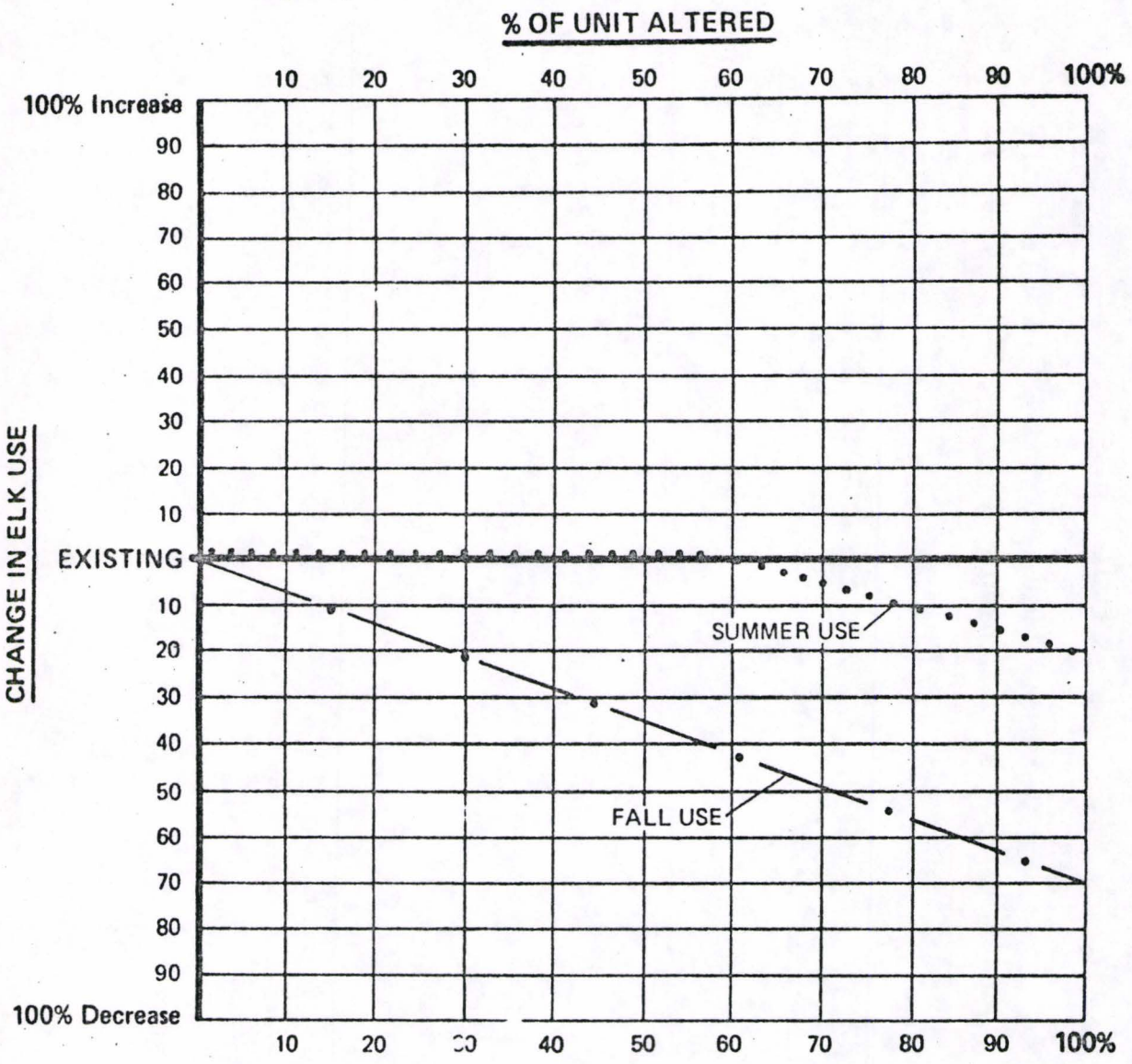
*Includes all possible combinations of the following:

a) Habitat Types:
S/Gatr; Clun; Eqar
AF/Gatr; Clun; Mefe; Alsi

b) P.I. Types:
Includes P.I. Types 11 and 14. Stand height greater than 40 feet. 70% to 100% crown cover (well stocked).

Assumptions:
Elk: Important summer and fall range.
Silviculture: All harvest systems applicable.

Figure 10. Elk Habitat Preference Model for Elk Habitat Types 42 and 43* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



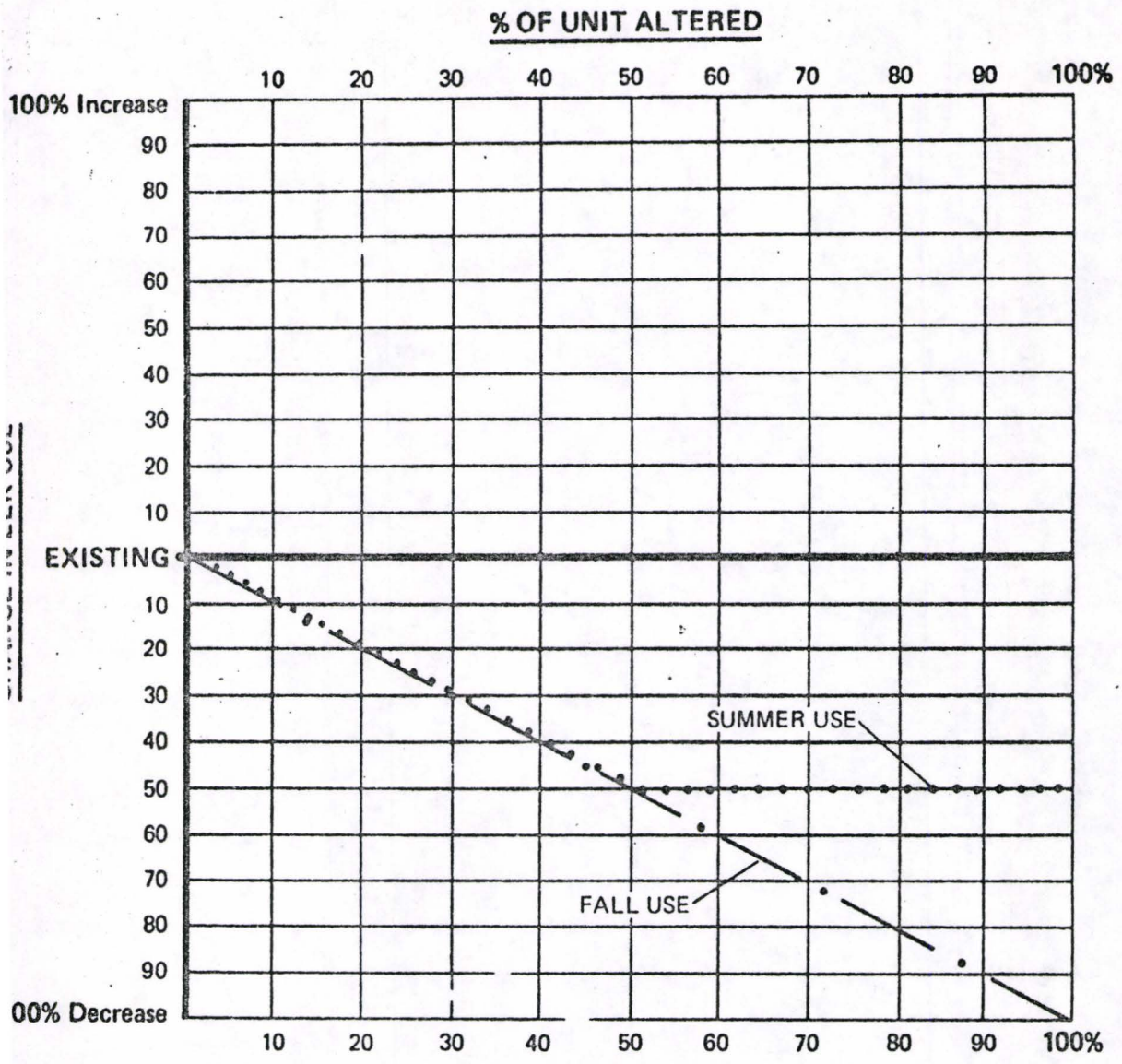
*Includes all possible combinations of the following:

a) Habitat Types:
S/Gatr; Clun; Eqar
AF/Gatr; Clun; Mefe; Alsi

b) P.I. Types:
Includes P.I. Types 12, 15, 17, 19, 21, and 23. Stand height greater than 40 feet. Stand may be two-storied and at least 15-20 feet height difference between overstory and understory. 40% to 100% crown cover (well to medium stocking).

Assumptions:
Elk: Important summer and fall range; key value is cover.
Silviculture: All harvest systems applicable.

Figure 11. Elk Habitat Preference Model for Elk Habitat Type 44* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



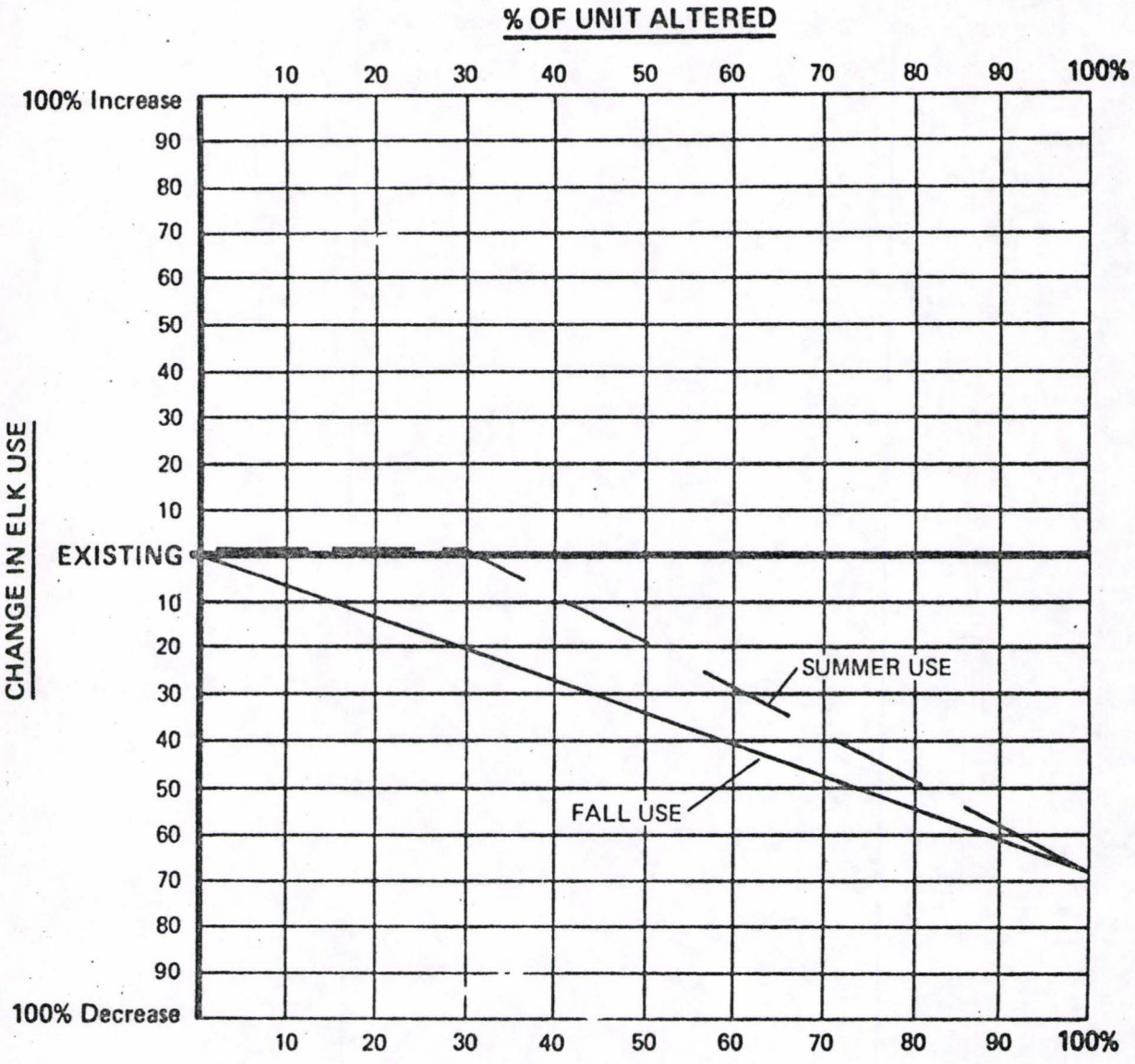
*Includes all possible combinations of the following:

a) Habitat Types:
S/Gatr; Clun; Eqar
AF/Gatr; Clun; Mefe; Alsi

b) P.I. Types:
Includes P.I. Types 25, 27, and 28. Stand height less than 40 feet. 40% to 100% crown cover (well to medium stocked).

Assumptions:
Elk: Summer and fall range; key summer habitat.
Silviculture: Intermediate cutting system.

Figure 12. Elk Habitat Preference Model for Elk Habitat Types 51 and 52* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



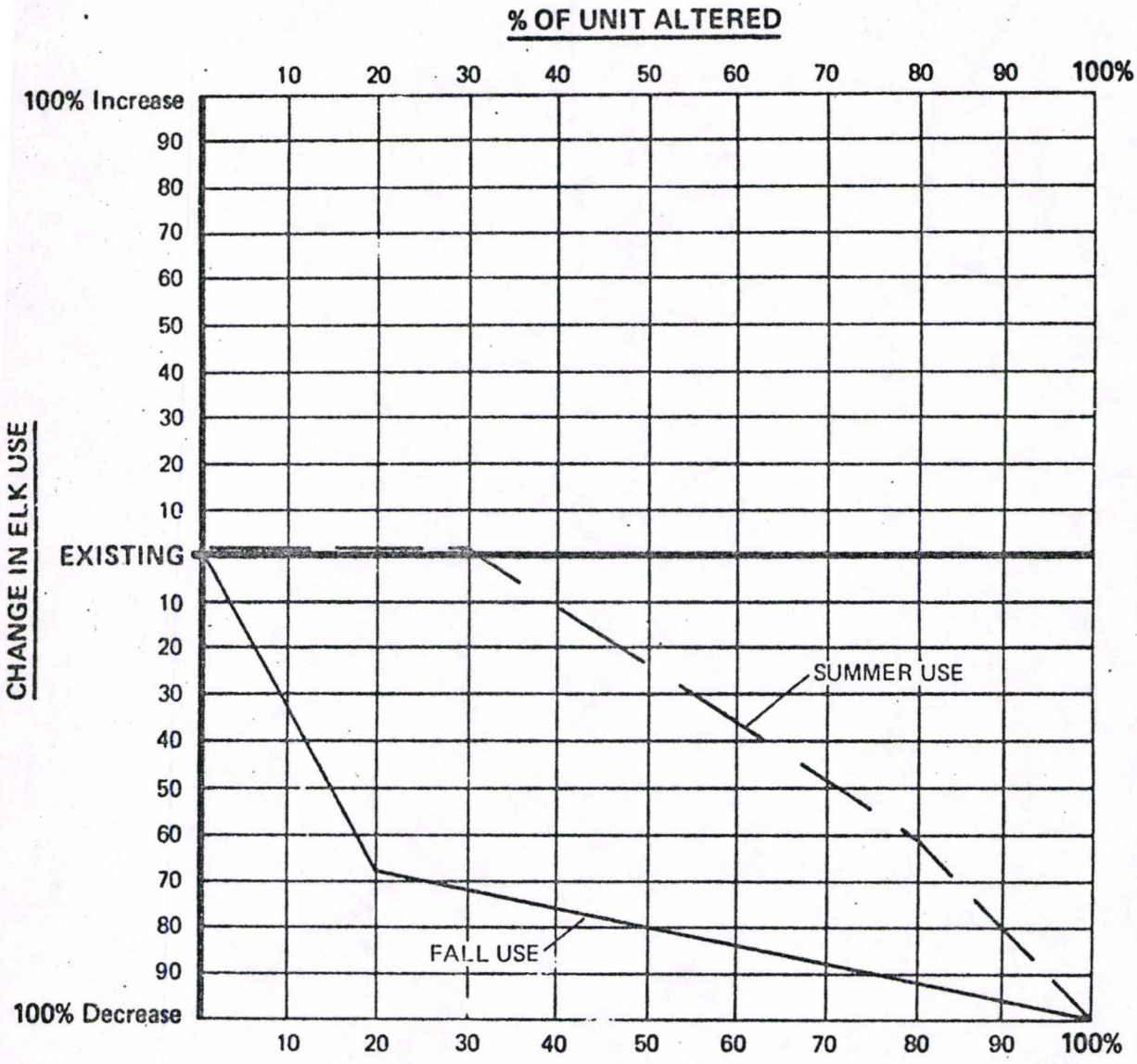
*Includes all possible combinations of the following:

a) Habitat Types:
AF/Caru; Cage; Arco; Clps; Vasc. S/Sest

b) P.I. Types:
Includes P.I. Types 11, 12, 13, 14, 15, 16, 18, 19, 21, 26, and 29. Crown cover ranges from 10% to 100%.

Assumptions:
Elk: Summer and fall range.
Silviculture: Even-aged harvest systems; most abundant and widely distributed type in Eastside Zone.

Figure 13. Elk Habitat Preference Model for Elk Habitat Type 53* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



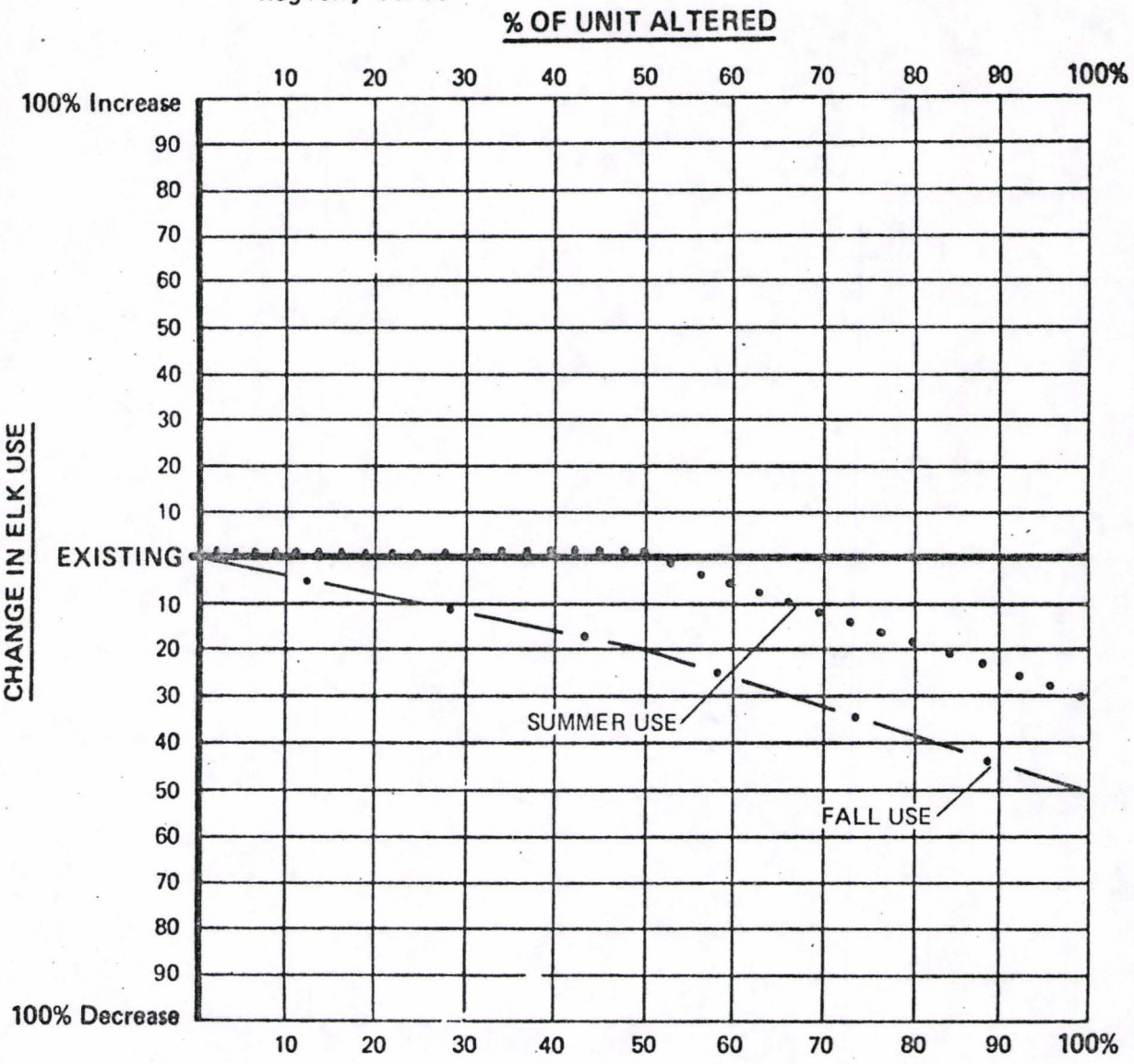
*Includes all possible combinations of the following:

a) Habitat Types:
AF/Caru; Cage; Arco; Clps; Vasc. S/Sest

b) P.I. Types:
Includes P.I. Types 17 and 23. Stand height greater than 40 feet. Stand two-storied and at least 15-20 feet height difference between overstory and understory. 40% to 100% crown cover (well to medium stocking).

Assumptions:
Elk: Summer and fall range.
Silviculture: Even-aged harvest systems; most abundant and widely distributed type in Eastside Zone.

Figure 14. Elk Habitat Preference Model for Elk Habitat Type 54* for the summer and fall periods, Eastside Zone, Northern Region, USFS.



*Includes all possible combinations of the following:

a) Habitat Types:
AF/Caru; Cage; Arco: Clps: Vasc. S/Sest

b) P.I. Types:
Includes P.I. Types 25, 27, and 28. Stand height less than 40 feet. 40% to 100% crown cover (well to medium stocked).

Assumptions:
Elk: Summer and fall range.
Silviculture: Intermediate cuts (commercial and precommercial thinning); conversion of "doghair" may result in clearcut.

HABITAT EFFECTIVENESS RELATIONSHIPS

The habitat effectiveness model portrays the capability of an area to provide security based on the density of open roads and the extent of available hiding cover. Security areas are those which hold elk during periods of stress. Habitat effectiveness is a concept which describes the probability that security habitat will be provided by an area.

Human intervention in the life system of elk can generate stress and the quality and quantity of hiding cover influences the degree and duration of stress. Thus, the interaction of these factors...human intervention and hiding cover quality...tend to determine the relative effectiveness of an area to provide security.

The habitat effectiveness model is based on the response of elk to stress generated during the hunting season. Stress created by other human activities (i.e., recreation or work activities) may also be a source of decreased effectiveness of a unit or habitat. Currently, hunting-based stress is the predominant form of human encroachment into elk security; however, man's non-hunting activities may be of increasing importance in the Eastside Zone. Data should be accumulated to describe the relationships of non-hunting based human encroachment.

The development of the habitat effectiveness model assumes current hunting regulations will remain relatively unchanged. More stringent hunting regulations such as the restriction of hunter numbers of the imposition of harvest quotas, would also reduce stress during the hunting season. However, these approaches are less desirable from the perspective of agency objectives (see Appendix III).

The degree of use of a road rather than the road itself, is the basis for negative impacts on an elk population (Marcum 1975). However, human access levels on each road are not currently manageable on the National Forests east of the Continental Divide. The day has yet to come when individual vehicle control is part of the management technique of the Forest Officer. We assume an "open" road will accommodate that degree of traffic which can negatively impact elk use. This assumption is the basis for use of road density (miles of road per square mile) as the measure of human intervention in the habitat effectiveness model.

Hiding cover quality, the other variable which affects the security of elk, is a function of sight distance (see Glossary) and relative expanse of the cover unit. We define hiding cover (see Glossary) as a vegetation and topographic complex which essentially hides an elk. However, for purposes of the development of habitat effectiveness model, timber stands with 40% or more canopy cover are considered elk hiding cover.

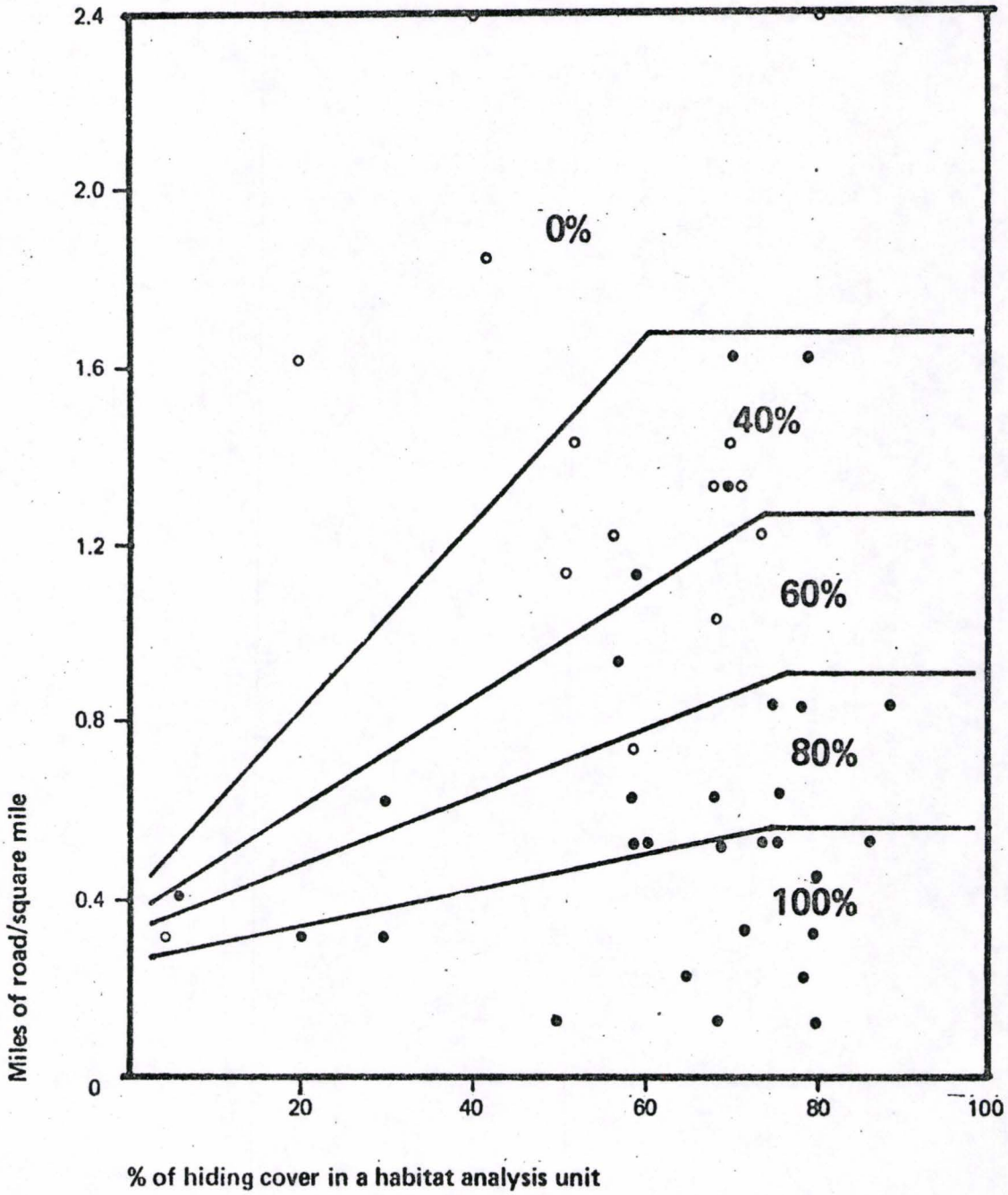
Telemetry studies (T. N. Lonner, pers. comm.) have shown the home range for elk during the summer-fall period is an area of approximately ten to forty square miles. This size is the basis for describing the Habitat Analysis Unit (HAU). The HAU also conforms to timber management compartment boundaries so certain inventoried forest characteristics can be easily retrieved from computer data banks. The model which depicts road density and hiding cover relationships is shown in Figure 15 and is derived as follows:

1. Road density and corresponding percentage of hiding cover (see Glossary) within an HAU were calculated from 43 samples from East-side Zone Forests. (Only half the length of peripheral roads in an HAU are used in this calculation.)

2. Field biologists determined the capability of these HAU's to "hold elk" (see Glossary).

3. Zones of probability (that an area will hold elk) were delineated (see Figure 15) based on similarities in the road density/percent cover relationship samples. The probabilities noted were devel through application of the binomial probability concept described by Snedecor and Cochran (1971) to the actual samples which occur in each probability zone.

Figure 15. Habitat Effe :iveness Model. The probability of the maintenance of security based on the relationship between road density and percentage of hiding cover in a habitat analysis unit (HAU).



• area does hold elk

o area does not hold elk

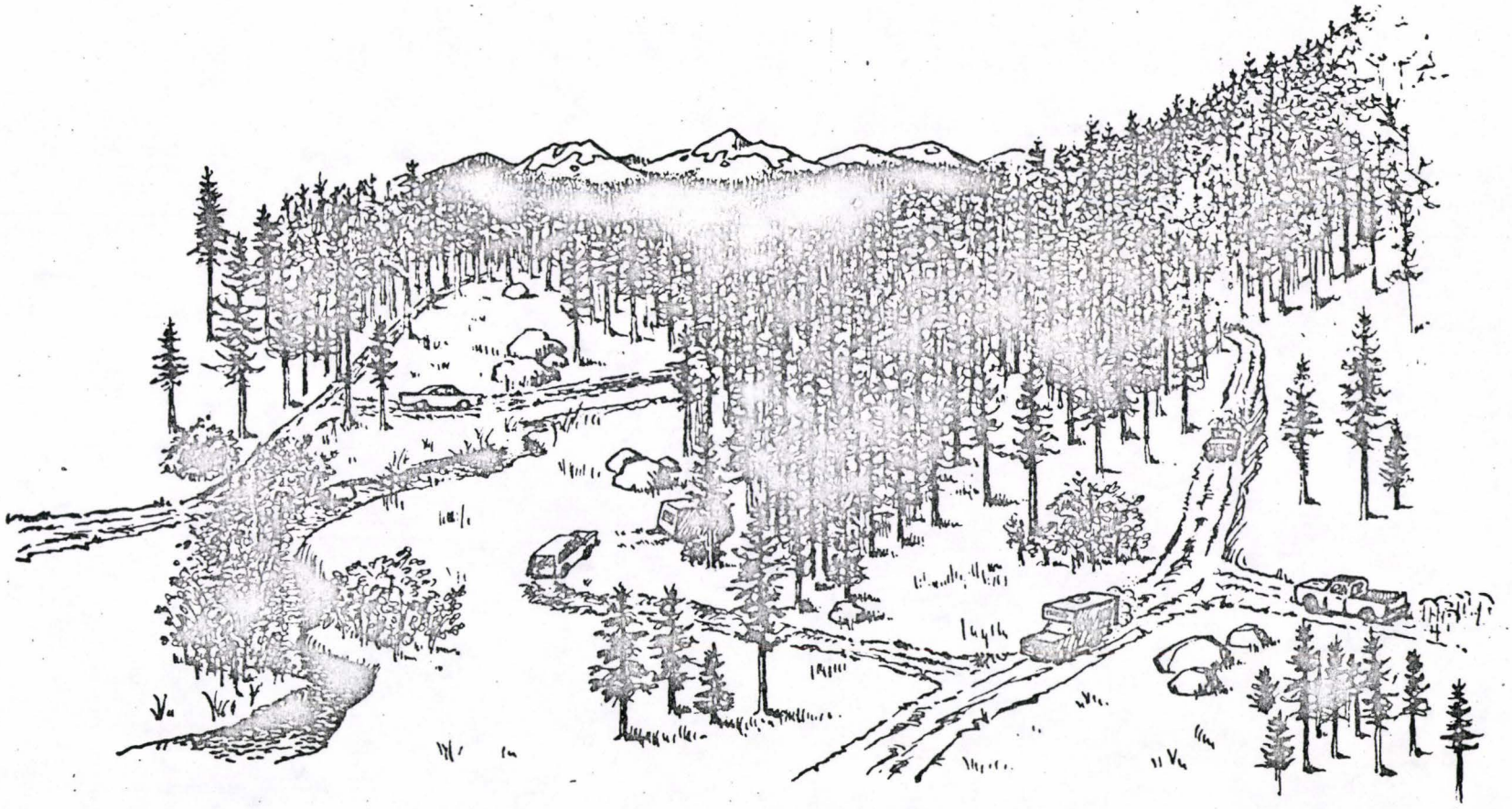


Figure 16. A sketch which illustrates reduced habitat effectiveness of an unlogged but heavily roaded segment of elk habitat (compare Figure 17).

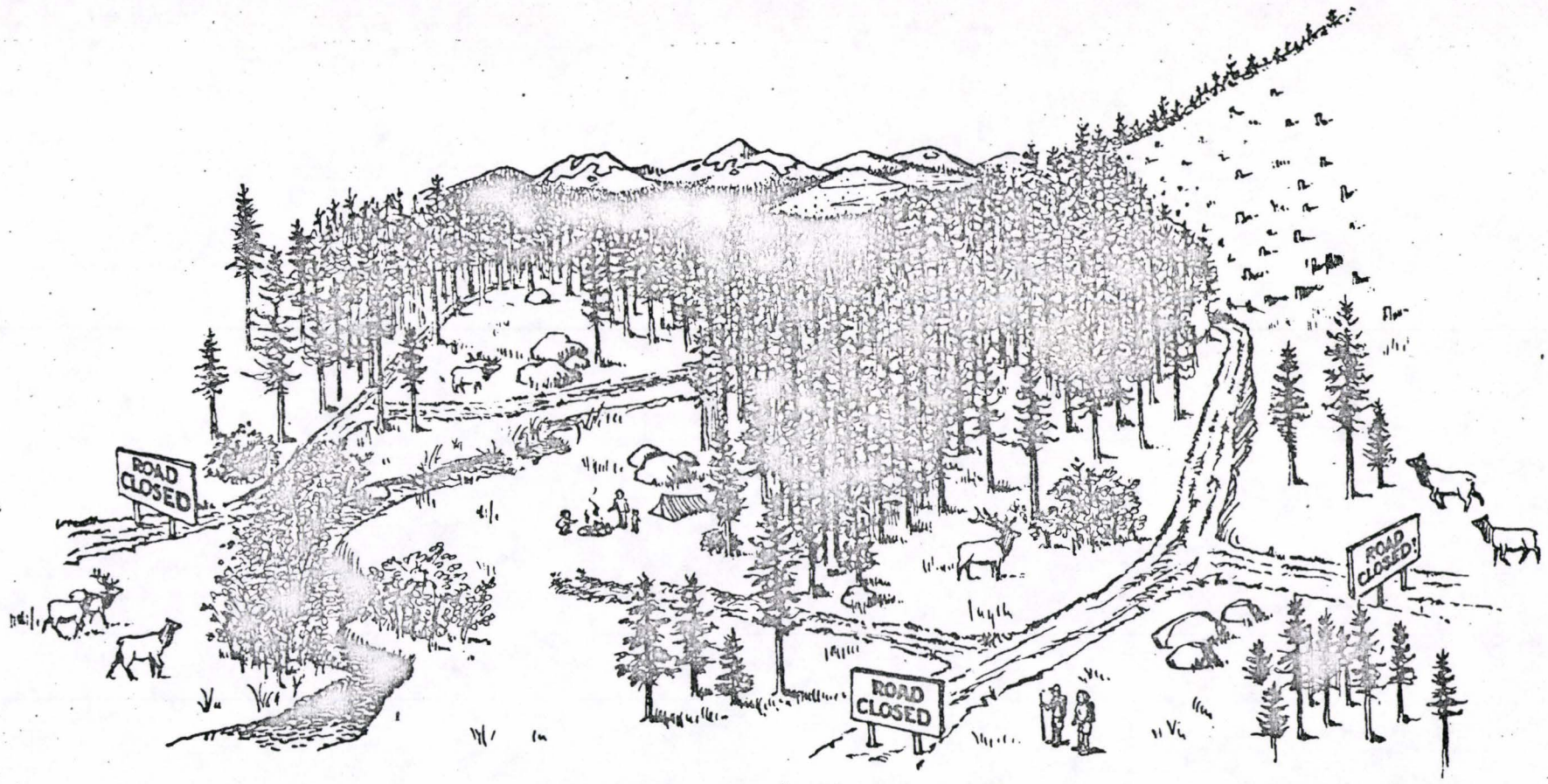
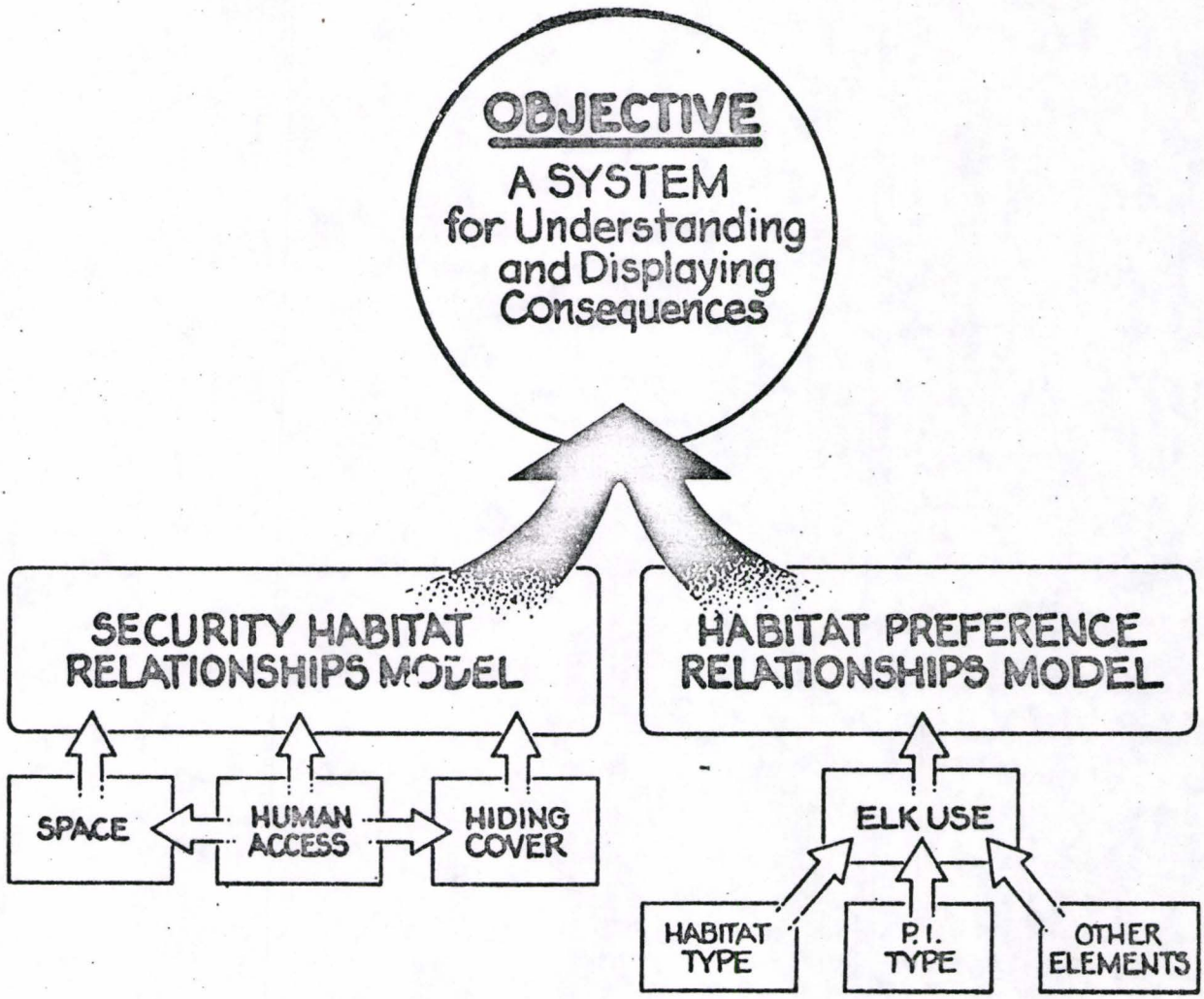


Figure 17. A sketch which illustrates improved habitat effectiveness due to road management despite moderate logging and high road density in a segment of elk habitat (compare Figure 16).

APPLICATION OF MODELS

A diagram which depicts the relationships of the components of the system as they relate to the stated objective is shown below. The overall system focuses on security habitat and habitat preference relationships. Both models must be employed before full understanding and display of the consequences of a land management decision on any unit of elk habitat can be achieved.



The intent of the security habitat and elk preference models is to serve, (1) as an aid in alternative *display* and *description* in the land use planning process and, (2) as an aid in the determination of potential projects in program planning (e.g. 5-year timber sale plan). The application procedure outlined below uses data from the Little Boulder/Whitetail Planning Unit, Deerlodge National Forest, as an illustration of the first application.

1. Define land management objectives with specific emphasis on elk, timber and road management (See Table 1). This step is unnecessary if the purpose is simply to describe a management proposal.

2. Delineate habitat analysis units (HAU). These should conform to timber management compartment boundaries and should range in size from 10 to 40 square miles. Thought should also be given as to a unit's manageability (See Figure 18).

3. State predominant or most limiting season of use for each HAU. Identify the seasonal use pattern which is most common or, if significant use occurs during more than one season, identify that which is most limiting to elk (See Table 2).

4. Establish maximum allowable alteration for each elk habitat type by season of use and by management alternative (See Table 3). To accomplish this, simply go to the appropriate elk habitat preference model for a given elk habitat type (e.g., See Figure 10 for elk habitat type 41). Then, select the percentage of unit altered value which corresponds with the given alternative (e.g., for elk habitat type 41 and management alternatives III, which is "essentially a neutral impact," the allowable alteration on summer range is 35% and on fall range is 0%). NOTE: To determine the current status of a given elk habitat type, all P.I. Types 31, 32, and 33 (cutover stands of less than 40 feet in height) should be grouped with adjacent stands which are classified the same as these P.I. Types 31, 32, and 33 were prior to their harvest. For example, let us suppose 80 acres of Elk Habitat Type 41 occurs adjacent to 20 acres of P.I. Type 31 which was, prior to harvest, classified as Elk Habitat Type 41. To predict the change in elk use created by any further alteration the two acreages should be added (80 + 20 = 100 acres) and the harvested acre divided by the total acreage to determine the amount of the unit already altered (20 ÷ 100 = 20%).

5. Summarize acreage of elk habitat type by HAU within the total area of consideration (See Table 4). This can be accomplished by a currently available computer program which accesses timber inventory data files.

6. Calculate maximum allowable alteration for each elk habitat type by HAU by management alternative (See Tables 5 and 6). This can be accomplished by a currently available computer program which combines Steps 4 and 5 of this procedure.

7. Select alternative or create others. Table 7 summarizes maximum allowable alteration for each HAU by management alternative. Selection can be based on predetermined alternatives, newly created alternatives or combination of alternatives by HAU depending on the overall land management objectives.

8. Calculate road density for each HAU. The road mileage within each HAU is compared with the percent hiding cover within that HAU (the latter data is made available from a currently available computer program which accesses timber inventory data files). Table 8 summarizes these aspects of elk habitat for the example area.

9. Select maximum road density which corresponds with selected alternative (Step 7). This procedure will identify road mileage which can be left open or is required to be closed (Table 9). In essence, it identifies the road management needs from an elk management perspective.

Table 1. The stated management alternatives for the Little Boulder/ Whitetail Planning Unit, Deerlodge National Forest.

ALTERNATIVE	DESCRIPTION
I	Provide for a maximum area of wilderness study emphasizing a low level of market outputs and a high level of non-market outputs (recreation, wildlife, fisheries, plus soil, air and water quality) on the remainder of the area. *For purposes of model application, this objective was interpreted to mean improvement of maximum amount of habitat with no new road development (100% habitat effectiveness).*
III	Emphasize minimal road development in support of market outputs while concentrating management for non-market outputs (dispersed recreation, wildlife, fish plus soil, air and water quality) on the remainder of the area. *For purposes of model application, this objective was interpreted to mean improve or at least maintain current situation -- essentially have a neutral impact (80% habitat effectiveness).*
V	Emphasize market outputs (livestock, timber, water, and minerals) which provide maximum economic support for the local area while maintaining current or minimally acceptable levels of other market and non-market outputs. *For purposes of model application, this objective was interpreted to mean all use could decrease (20% of maximum) and road development would increase (40% habitat effectiveness).*

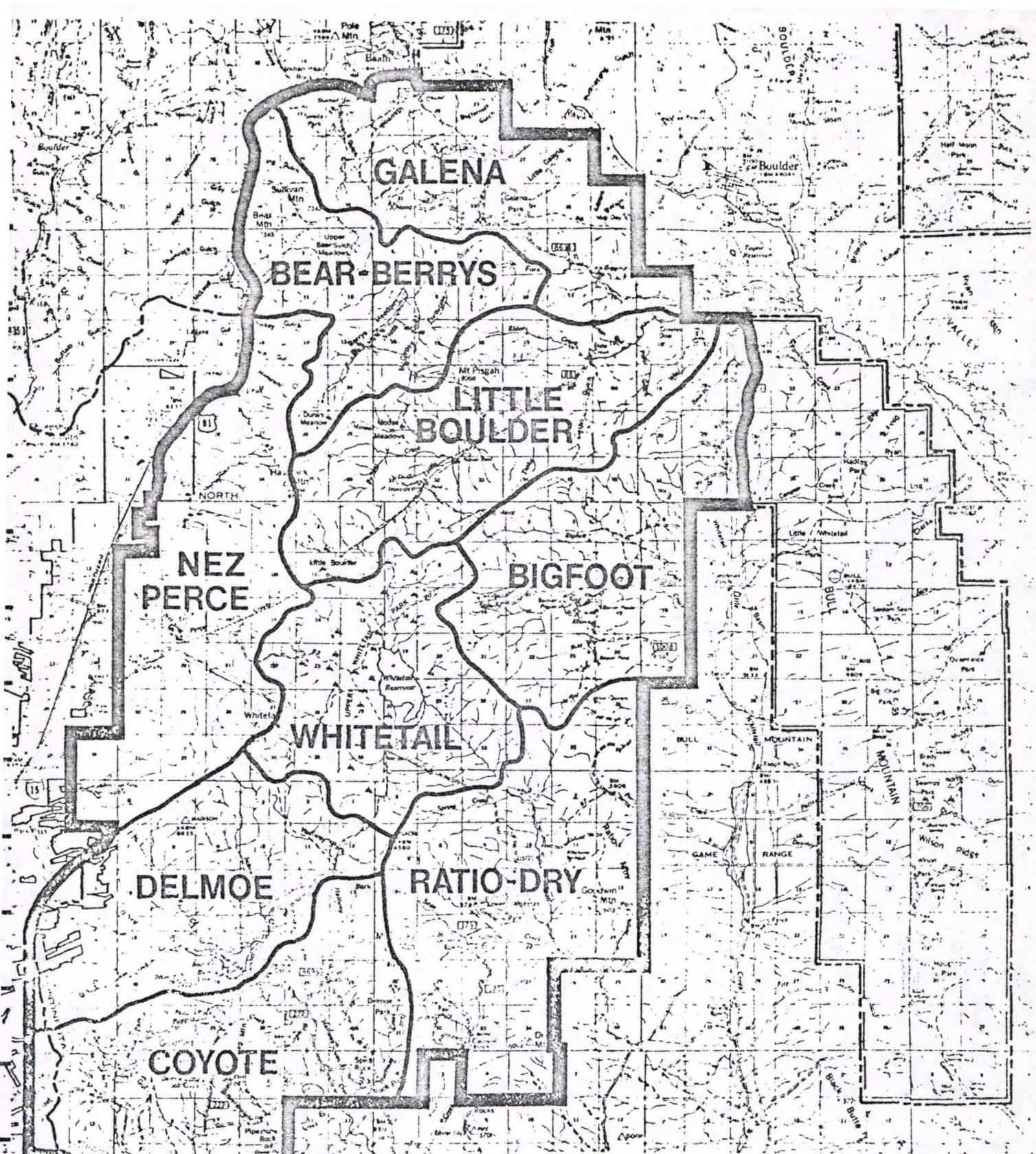


Figure 18. Habitat Analysis Units in the Little Boulder/Whitetail Planning Unit, Deerlodge National Forest.

Table 2. Identification of seasonal elk use by Habitat Analysis Unit (HAU) in the Little Boulder/Whitetail Planning Unit, Deerlodge National Forest.

PREDOMINANT SEASON OF USE	HAU
Fall	Coyote Ratio/Dry Galena Bigfoot
Summer	Delmoe Nez Perce Whitetail
Summer & Fall *	Little Boulder Bear/Berrys

* Fall use most limiting

Table 3. Maximum alteration (%) in elk habitat use by management alternative in the Little Boulder/Whitetail Planning Unit, Deerlodge National Forest, based on elk habitat preference models.

Elk Habitat Type	Alternative I		Alternative III		Alternative V	
	Summer	Fall	Summer	Fall	Summer	Fall
11	0	0	0	5	45	45
12	0	0	0	5	45	45
13	0	0	0	5	45	45
14	0	0	0	5	45	45
21	15	0	0	0	50	30
22	15	0	45	5	65	55
23	0	0	10	0	65	10
24	0	0	0	0	40	10
31	20	15	40	25	60	45
32	20	15	40	25	60	45
33	30	0	40	0	55	10
34	0	0	50	10	90	65
41	25	0	35	0	60	40
42	0	0	60	0	100	30
43	0	0	60	0	100	30
44	0	0	0	0	20	20
51	0	0	30	0	50	30
52	0	0	30	0	50	30
53	0	0	30	0	45	5
54	0	0	50	10	80	50

Table 4. Summary of elk habitat types in all habitat analysis units in the Little Boulder/Whitetail Planning Unit, Deerlodge National Forest.

k Habitat	Coyote		Delmoe		Ratio/Dry		Whitetail		Nez Perce		Bigfoot		L. Boulder		Bear/Berrys		Galena	
	Ac.	%	Ac.	%	Ac.	%	Ac.	%	Ac.	%	Ac.	%	Ac.	%	Ac.	%	Ac.	%
11	755	4	30	0	1762	8	0	0	15	0	0	0	35	0	20	0	120	1
12	2939	15	725	5	4729	22	0	0	135	1	2520	14	1410	7	285	2	2519	17
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0
14	0	0	10	0	230	1	0	0	0	0	0	0	0	0	0	0	0	0
21	1400	7	580	4	677	3	0	0	900	4	1200	7	985	5	1020	8	2709	18
22	3940	20	2050	13	3895	18	25	0	1930	10	2243	12	1174	6	1765	14	3290	22
23	0	0	25	0	0	0	0	0	0	0	0	0	25	0	0	0	40	0
24	790	4	470	3	300	1	0	0	0	0	645	4	0	0	0	0	359	2
31	0	0	40	0	85	0	310	2	1674	8	550	3	1260	6	995	8	415	3
32	0	0	65	0	75	0	225	1	768	4	75	0	1002	5	940	7	225	2
33	0	0	0	0	0	0	15	0	20	0	0	0	0	0	0	0	0	0
34	0	0	0	0	15	0	195	1	0	0	0	0	0	0	0	0	65	0
41	0	0	140	1	0	0	65	1	275	1	0	0	110	1	155	1	30	0
42	0	0	160	1	30	0	75	1	805	4	0	0	321	2	215	2	55	0
43	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	225	1	1530	10	40	0	1265	8	2081	10	1395	8	1632	0	1385	11	230	2
52	640	3	5375	34	375	2	5720	37	2640	13	635	4	5955	30	3874	30	630	4
53	0	0	50	0	0	0	0	0	0	0	0	0	30	0	0	0	35	0
54	0	0	155	1	0	0	15	0	0	0	525	3	495	2	0	0	0	0
)ther types	9390	47	4385	28	8410	42	7692	49	9183	45	8249	46	5385	27	2380	18	4145	28
		100		100		100		100		100		100		100		100		100
TOTAL	20079		15790		21228		15602		20426		18037		19854		13049		14912	

Table 5. Maximum allowable alteration (acres) in the Ratio/Dry Habitat Analysis Unit by elk habitat type and management alternative based on habitat preference models.

Elk Habitat Type	Alternative I	Alternative III	Alternative V
11	0	352	617
12	0	946	1655
13	0	0	0
14	0	46	81
21	0	0	203
22	0	195	2142
23	0	0	0
24	0	0	30
31	13	21	38
32	8	15	30
33	0	0	0
34	0	2	11
41	0	0	0
42	0	0	9
43	0	0	0
44	0	0	0
51	0	0	6
52	0	0	38
53	0	0	0
54	0	0	0
TOTAL	21	1577	4860

Table 6. Maximum allowable alteration (acres) in the Nez Perce Habitat Analysis Unit by elk habitat type and management alternative based on habitat preference models.

Elk Habitat Type	Alternative I	II	III
11	0	3	5
12	0	27	47
13	0	0	0
14	0	0	0
21	135	315	450
22	290	965	1255
23	0	0	0
24	0	0	0
31	335	670	1088
32	115	269	422
33	0	7	11
34	0	0	0
41	69	96	165
42	0	483	805
43	0	0	0
44	0	0	0
51	0	624	1249
52	0	528	1320
53	0	0	0
54	0	0	0
TOTAL	944	3987	6817

Table 7. Summary of maximum allowable alteration (acres) by management alternative based on habitat preference models in the Little Boulder/Whitetail planning unit, Deerlodge National Forest.

HAU	Alternative I	Alternative III	Alternative V
Coyote	0	936	4057
Delmoe	448	3219	6165
Ratio/Dry	21	1577	4860
Whitetail	116	1919	4272
Nez Perce	944	3987	6817
Bigfoot	91	822	3381
Little Boulder	289	913	3688
Bear/Berrys	243	591	2937
Galena	85	860	4057
TOTAL	2237	14824	40234

Table 8. Current status of some elk habitat elements by Habitat Analysis Unit (HAU) in the Little Boulder/Whitetail Planning Unit, Deerlodge National Forest.

HAU	Area (Sq. Miles)	Miles of Road	Miles of Road Per Sq. Mile	% Hiding Cover
Coyote	31.4	97.4	3.1	53
Delmoe	24.7	18.4	0.7	72
Ratio/Dry	33.2	35.1	1.1	58
Whitetail	24.4	8.0	0.3	51
Nez Perce	21.9	8.7	0.3	55
Bigfoot	28.2	22.9	0.8	54
Little Boulder	31.0	13.8	0.4	73
Bear/Berrys	20.4	10.3	0.5	82
Galena	23.3	27.3	1.2	72
TOTAL	251.2	241.9	--	--
Unit Mean	27.9	26.9	0.9	63
Unit Median	28.2	18.4	0.7	58

Table 9. Road management alterations required at hiding cover levels established by management alternative, in the Little Boulder/ Whitetail Planning Unit, Deerlodge National Forest.

	Alternative I		Alternative III		Alternative IV	
HAU	Miles Road/ Sq. Miles	Miles	Miles Road/ Sq. Miles	Miles	Miles Road/ Sq. Miles	Miles
Coyote	-2.7*	-84.8	-2.2	-69.1	-1.7	-53.4
Delmoe	-0.2	- 4.9	+0.5	+12.4	+0.9	+25.6
Ratio/Dry	-0.7	-23.2	-0.1	- 3.3	+0.4	+13.3
Whitetail	+0.1	+ 2.4	+0.6	+14.6	+1.1	+26.8
Nez Perce	+0.1	+ 3.2	+0.6	+19.1	+1.1	+35.1
Bigfoot	-0.4	-11.3	+0.2	+ 5.6	+0.7	+19.7
Little Boulder	+0.1	+ 3.1	+0.8	+24.8	+1.2	+37.2
Bear/Berrys	0	0	+0.7	+14.3	+1.1	-22.4
Galena	-0.7	-16.3	-0.4	- 9.3	+0.4	+ 9.3
Net Change		-122.0		+ 8.6		+136.0
Ave. Unit Alter.		16.6		19.2		27.0

*Negative value indicates roads must be closed to meet management alternative goals, while positive value indicates roads may be added.

MANAGEMENT CONSIDERATIONS

1. Minimum disturbance of winter range use occurs where the following are incorporated into logging plans:

   a) Avoid logging activities including hauling, in the winter range zone during periods of elk use (December through April).

   b) Any logging system which maintains the integrity of winter thermal cover is appropriate.

   c) Due to the proximity to south-facing forage types, the upper one-third of the slope is particularly important as winter thermal cover (Beall, 1976).

2. In known calving areas, avoid logging activities, including hauling during calving period (May and June).

3. Road location impacts on elk will be minimized where consideration is given to the following (Montana Cooperative Elk-Logging Study, 1976):

   a) Road crossing by elk is maximized where frequent, dense cover areas are left intact.

   b) Elk frequent low divides when crossing between drainages.

   c) Elk use of important habitats is least impacted where road designs call for low standard, slow speed, single track roads.

   d) Elk movements are least impeded where road right-of-way slash is completely disposed.

   e) Roads in riparian zones lessen elk use in this important habitat situation.

4. Two general types of summer range situations have been identified by the Montana Cooperative Elk-Logging Study (1976). Both of these situations center on moist habitat types and include those habitat types found in habitat type group number 4 (Appendix I, Table 1). The *first* type occurs where moist sites are found in close proximity to each other. Here, an area large enough to maintain the overall integrity of the habitat components to be managed should be determined by an on-the-ground inspection by land and wildlife managers and other appropriate resource specialists. A *second* type of situation exists, where moist sites are not in close proximity with one another, but evenly distributed over the summer range. The recommendation to protect moist sites which are relatively far apart but evenly distributed over a summer range, as well as a security zone of cover around each site, may be impractical. However, it should be

recognized that continual loss of these small units and their juxtaposition in the forest could in time have a substantial adverse impact on a local elk herd. Therefore, as many as possible of these sites should be identified and withdrawn from treatment, along with a peripheral zone to provide continuous cover with the uncut forest. New or planned roads passing near these sites should be closed to summer-fall vehicular traffic, except perhaps for light intermittent administrative use, following logging in the area.

5. Clearcuts have maximum elk use potential when the following criteria are met (Montana Cooperative Elk-Logging Study, 1976):

   a) Slash cleanup inside clearcuts should maintain average slash depths of less than 1.5 feet.

   b) Small openings appear to be preferred, but larger openings (up to 100 acres) may be used where the adjacent forest is relatively free of understory debris and security is adequate.

   c) Design and location of clearcut units should provide for the shortest possible sight distances (best available cover) at the unit boundary.

   d) Provide for security through appropriate road closures.

6. Natural openings in the forest canopy generally have high value for elk. Maximum use of such openings can be expected where hiding cover is preserved within three sight distances (approx. 600 ft.) of the edge. When timber harvest occurs adjacent to this edge and a selection system is silviculturally sound, it should be used to fulfill this objective. Where clearcutting is necessary, it is desirable to maintain at least three-fourths of the residual cover around the opening at any one entry. Subsequent entries should be delayed until hiding cover is re-established on previously harvested units.

7. Timber management operations are a disturbance to elk. The adverse consequences can be minimized by the following (Black, et. al. 1976):

   a) Concentrate all management activities (road construction, logging, slash treatement, planting) within the shortest possible period of time and the smallest possible area. The more severe the disturbance, the greater the need to concentrate these activities.

   b) Confine operations to a single drainage at a time, i.e., do not log adjacent drainages as the disturbances appear to be

effectively dampened by ridgelines. Conscious designation of non-activity zones adjacent to concentrated activity areas is required.

c) Minimize the duration of the disturbance. An intensive disturbance for a short time probably has less impact than a lesser disturbance over a long period of time.

GLOSSARY

A. Elk Habitat Type. The vegetation classification which combines habitat type and photointerpretation type (PI) is known as elk habitat group (see Appendix I). This classification best describes seral vegetation stages.

B. Habitat Analysis Unit (HAU). This unit is a timber management compartment or combination of compartments which ranges in size from 10 to 40 square miles. This size approximates the average seasonal home range for elk during the summer/fall period.

C. Hiding Cover. Hiding cover is defined as the vegetation and topographic complex capable of essentially hiding an elk. Hiding cover includes those areas in excess of 40% canopy coverage with sight distances up to 200 feet.

D. Holds Elk. An area holds elk when it has the physical characteristics necessary to provide security such that those elk present will remain when human encroachment occurs in elk habitat.

E. Road. All roads, trails, or wheel tracks wherever a 4-wheeled motorized vehicle travels are considered a road for the purpose of road density computation. When a road is administratively closed to all vehicle traffic, it is judged as if no road exists.

F. Security Area. An area, because of its geography, topography and/or vegetation that will hold elk during periods of stress. Security is a function of space and hiding cover, as influenced by human access. The size of the area necessary to provide security will vary with degree of access and hiding cover characteristics.

G. Sight Distance. That distance in which an elk becomes essentially hidden.

H. Standard Diameter. An expression of home range, one standard diameter describes the diameter of a circle which presumably contains at least 68% of the animal's activity. It is calculated after Harrison (1958).

I. Thermal Cover. Is provided by a stand of coniferous trees which aids the conservation of energy needed for thermo-regulation of the species. For elk, optimum thermal cover is at least 40' tall trees with a minimum of 70% canopy cover. Where such stands are not present, thermal cover is provided by lesser trees.

The need for thermal cover is critical on all winter ranges but requirements for thermal cover are not well understood in other seasonal habitats. Within winter thermal cover, larger diameter or "wolf trees" may have key values. Also, in some winter range situations, the timber canopy provides the only means of preventing crusting of the snowpack which covers forage types. Here, optimum canopy cover ranges from 40% to 70%.

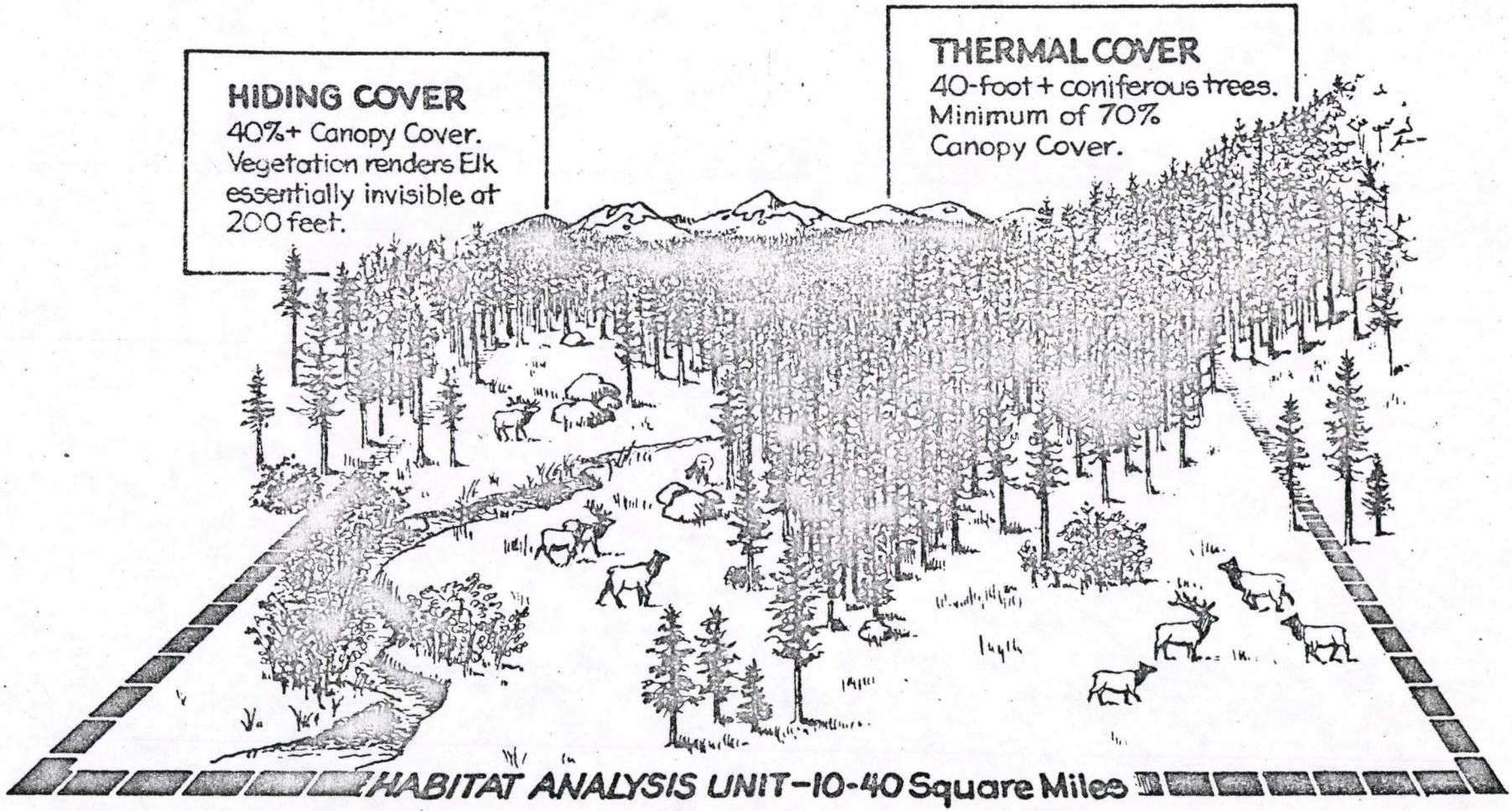


Figure 19. A sketch which illustrates some key concepts in Eastside Zone Elk/Timber Relationships.

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APPENDIX I

TABLE I. Habitat Type Group Numbers Resulting from Grouping of Similar Habitat Types.

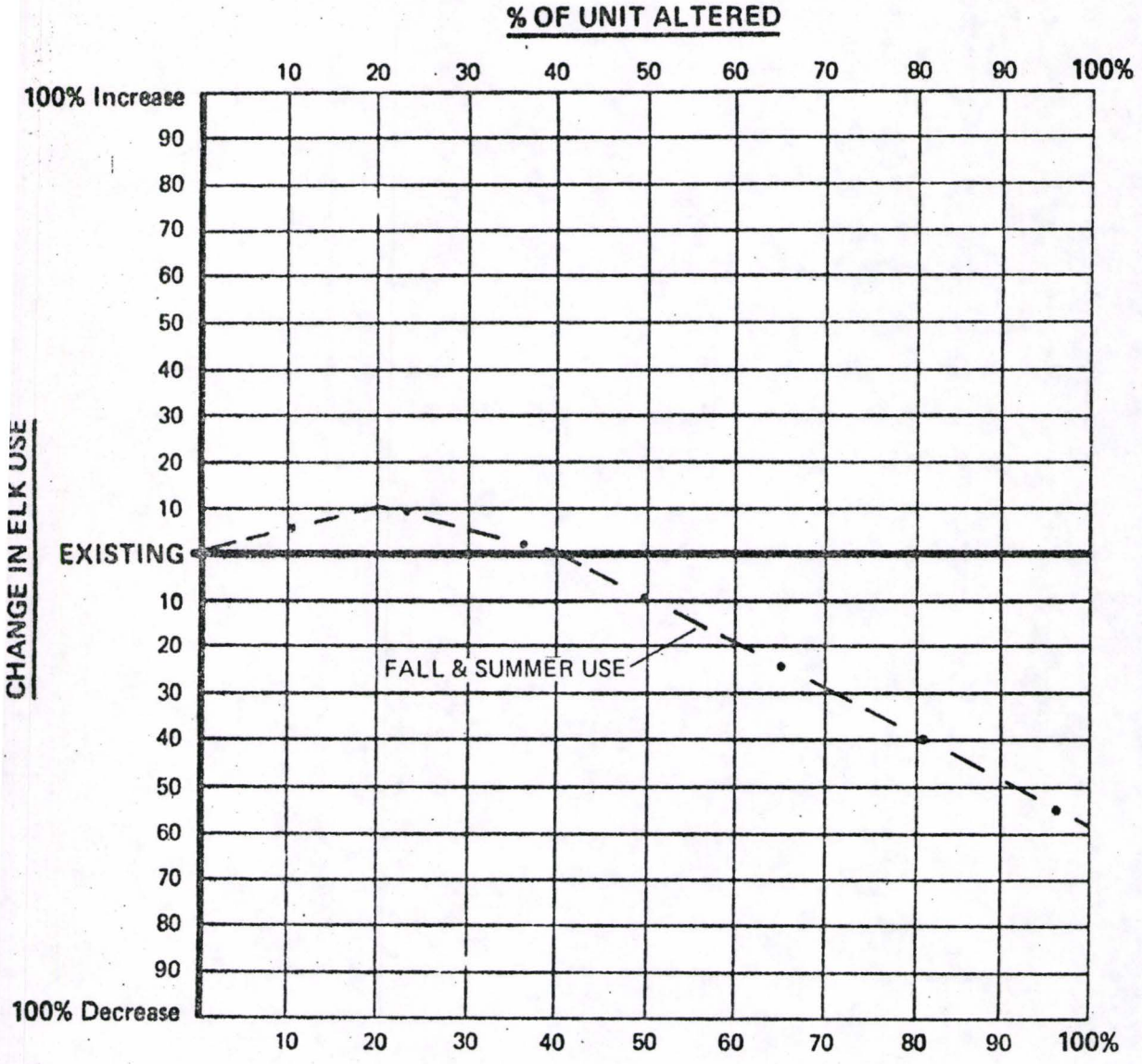
Habitat Type Group No.	Habitat Types Included
1	Pinus Flexilus Series PP/Agsp; Andro; Feid; Putr; Syal DF/Agsp; Feid; Fesc. DF/Syal-Agsp; Caru-Agsp
2	DF/Caru-Caru; Caru-Aruv; DF/Cage DF/Arco; Juco; Spbe; Aruv; Phma; Syal
3	DF, S, AF/Vaca; Libo S/Smst; Phma AF/Xete; Vagl; DF/Vagl
4	S/Gatr; Clun; Eqar AF/Gatr; Clun; Caca; Mefe; Alsi
5	AF/Caru; Cage; Arco; Clps; Vasc. S/Sest
6	AF/Luhi; AF(WBP)/Vasc. AF/Rimo WBP. WBP-AF. AL-AF.
7	LPP/Putr

TABLE II. P.I. Type Group Numbers Resulting From Grouping Similar P.I. Types.

P.I. Type Group No.	Description
1	Includes P.I. Types 11 and 14. Stand height greater than 40 feet. 70% to 100% crown cover (well stocked).
2	Includes P.I. Types 12, 15, 19 and 21. Stand height greater than 40 feet. 40% to 70% crown cover (medium stocking).
3	Includes P.I. Types 17 and 23. Stand height greater than 40 feet. Stand two-storied and at least 15-20 feet height difference between overstory and understory. 40% to 100% crown cover (well to medium stocking).
4	Includes P.I. Types 25, 27 and 28. Stand height less than 40 feet. 40% to 100% crown cover (well to medium stocked).
5	Includes P.I. Types 13, 16, 18, 26 and 29. Crown cover less than 40% (poorly stocked).
6	Includes P.I. Types 31, 32, 33. Stand heights less than 40 feet. Cutover areas of variable stocking.

APPENDIX II

Figure 1. Elk Habitat Preference Model for Elk Habitat Types 71, 72, 73, and 74* for the winter and fall periods, Eastside Zone, Northern Region, USFS.

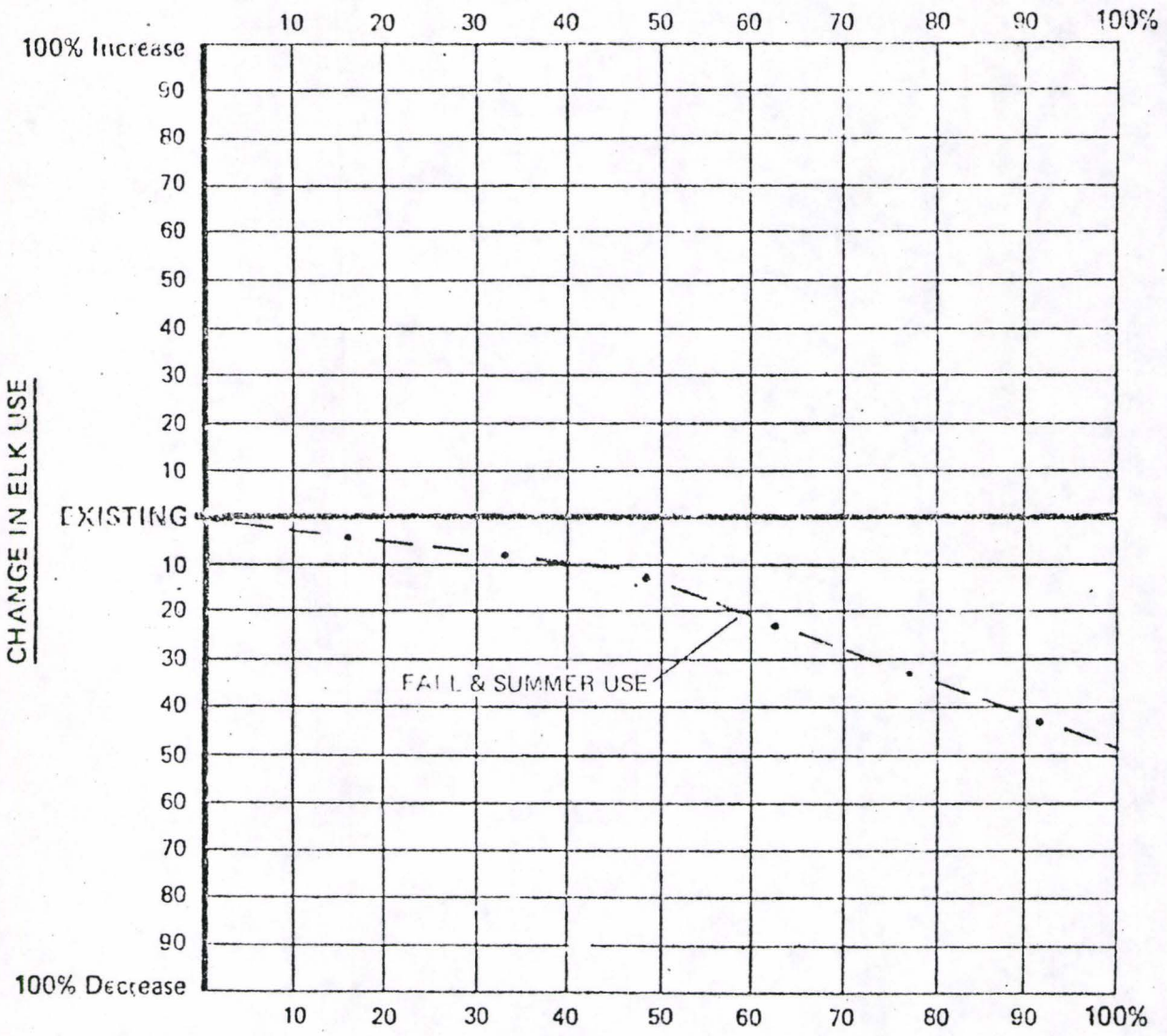


*Habitat Types:
LPP/Putr

PI Types:
All PI types with crown cover 40% or greater (medium to well stocked).

Assumptions:
Elk: Fall and winter range.
Silviculture: Primarily even-aged harvest but some selection harvest possible.

Figure 2. Elk Habitat Preference Model for Elk Habitat Type 75* for the winter and fall periods, Easeside Zone, Northern Region, USFS.



*Habitat Types:
LPP/Putr

PI Types:
Includes P.I. Types 13, 16, 18, 26, and 29.
Crown cover less than 40% (poorly stocked).

Assumptions:
Elk: Fall and winter range.
Silviculture: Primarily even-aged harvest but some selection harvest possible.

Appendix III. Agency Objectives Relating to Dispersed Recreation.

FOREST SERVICE

"The goal for this system (RECREATION) is to increase the supply of outdoor recreation opportunities and services through Forest Service programs which emphasize dispersed recreation." (RPA Summary, USDA Forest Service).

MONTANA DEPARTMENT OF FISH AND GAME

"To protect and perpetuate elk and their habitat and to increase the supply of available, harvestable elk to meet demands for hunting and non-hunting recreation. To provide 800,000 days of elk hunting annually at a hunting success rate of 15 percent and an average hunting effort of 50 days/elk harvested by 1980."*

PAST, CURRENT AND PROPOSED MANAGEMENT PARAMETERS FOR ELK*

	Hunting Success	Elk Hunting Recreation Days
1971	16%	514,800
1972	14%	552,700
1973	19%	641,700
1974	12%	719,000
1975	16%	650,000
1980	*15%*	*800,000 (Objective)*

*Adapted from Strategic Wildlife Management Plan, Montana Dept. of Fish and Game, 3rd. Draft.

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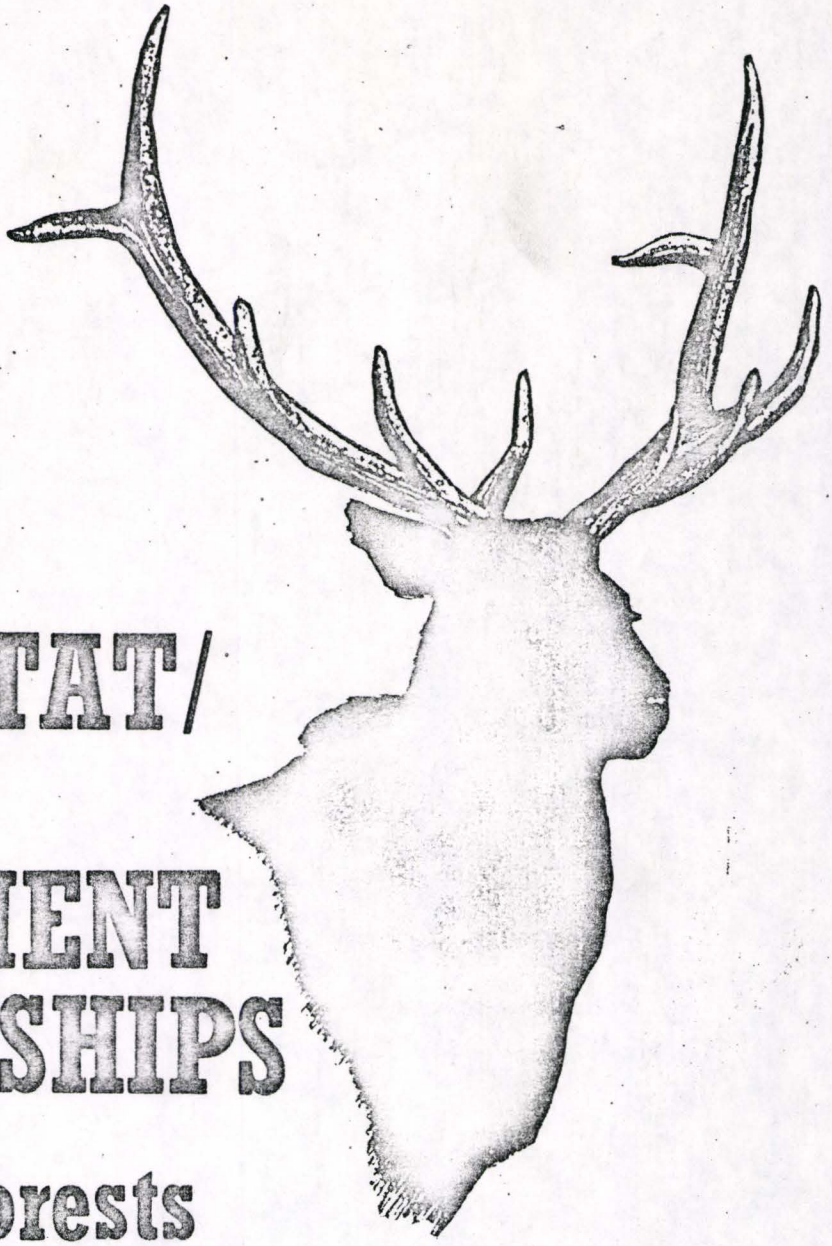

ELK HABITAT/ TIMBER MANAGEMENT RELATIONSHIPS

on Eastside Forests of the Northern Region, USFS

Northern Region, USFS and
Montana Department of Fish and Game

MARCH, 1978